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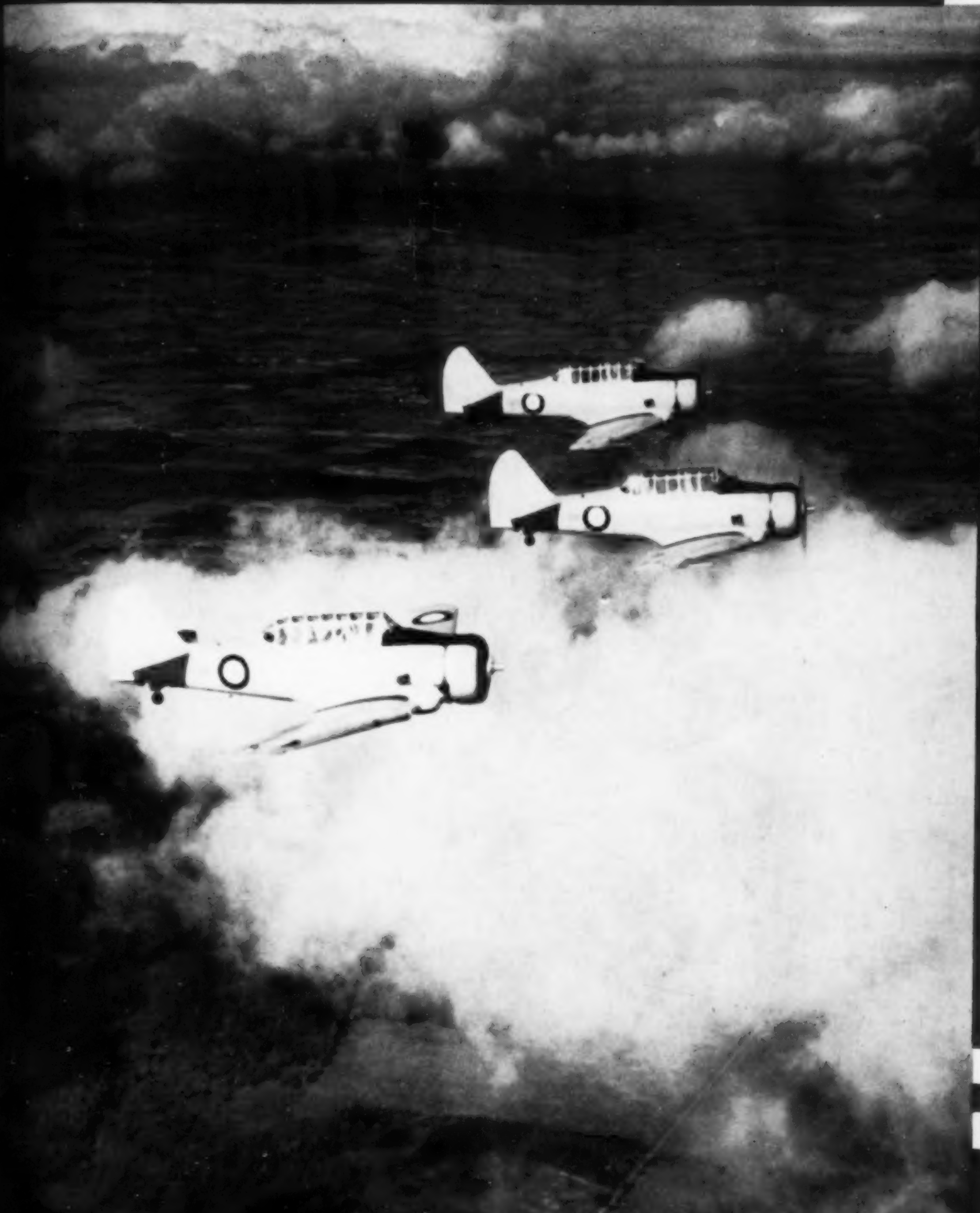

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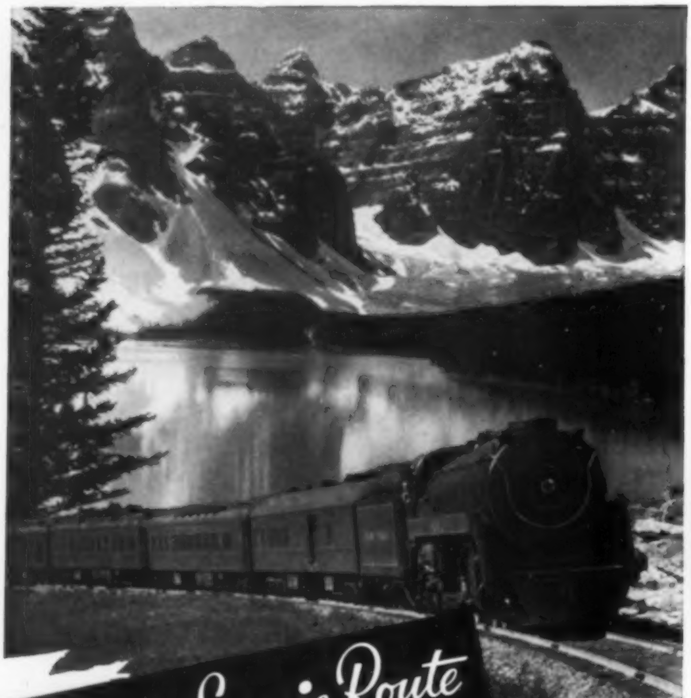

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CANADIAN GEOGRAPHICAL JOURNAL

Editor - *Gordon M. Dallyn*

49 METCALFE STREET, OTTAWA

This magazine is dedicated to the interpretation, in authentic and popular form, with extensive illustrations, of geography in its widest sense, first of Canada, then of the rest of the British Commonwealth, and other parts of the world in which Canada has special interest.

Contents

JULY 1940 VOLUME XXI No. 1

COVER SUBJECT:—Three "Harvard" aircraft in flight over the R.C.A.F. Station, Camp Borden, Ontario.

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The British standard of spelling is adopted substantially as used by the Dominion Government and taught in most Canadian schools, the precise authority being the Oxford Dictionary as edited in 1936.

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DUNLOP FORT
Specify
DUNLOP 'FORT'
'THE WORLD'S FINEST TIRE'

Three North American "Harvard" training aircraft above the Service Flying Training School at the R.C.A.F. Station, Camp Borden, Ontario.

BRITISH COMMONWEALTH AIR TRAINING PLAN

***by* FLYING OFFICER J. FERGUS GRANT**

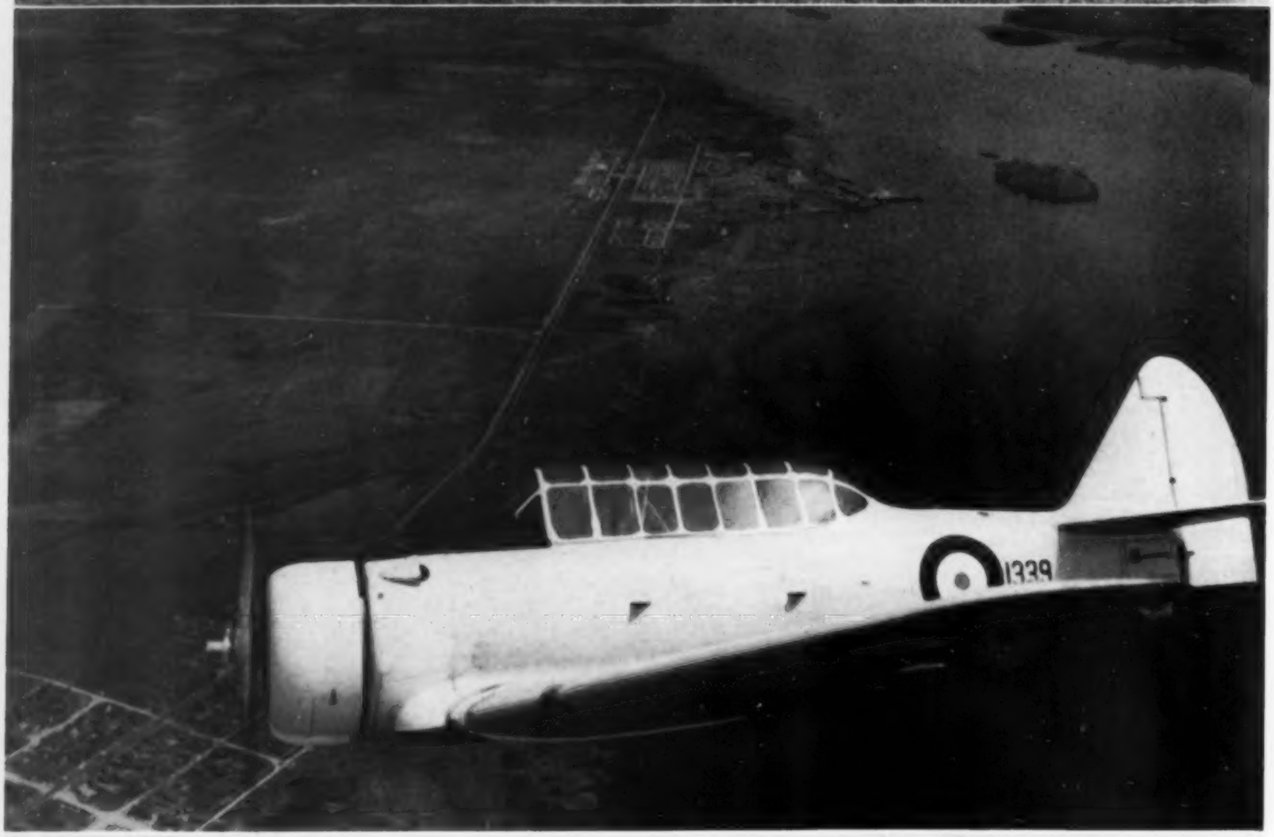
AIR supremacy is now the goal of the British. Catapulted into another great war, the imminency of which they were loath to face with realistic candour and for which they had but meagrely and reluctantly prepared, the British soon realized that, if ultimate victory was to be theirs, mastery of the air would inevitably be the deciding factor.

To train aircrews in such numbers as would bring the Royal Air Force to the desired strength was an undertaking greater than the physical limitations of the British Isles could permit.

The area of those islands, less than one-third the size of Ontario, gives little scope for the flying of thousands of training planes, and they were never more vulnerable than now with the collapse of coastal nations of Europe.

The production of pilots, air observers and air gunners in large numbers is limited by the relatively small number of aerodrome sites available, and the short distance between these renders hazardous the movement of many aircraft through English and Scottish skies. Furthermore, the majority will now be required for operational rather than for training purposes.

The British Isles are frequently shrouded in fog, which restricts the number of flying days. Forced landings by im-



Top:—De Havilland "Tiger Moth", which is used for the elementary training of pilots under the Joint Air Training Plan.
Centre:—North American "Harvard" trainer banks steeply over Trenton town. The R.C.A.F. Station, with aerodrome and the Bay of Quinte, are beyond.
Bottom:—Fleet "Finch", a training type of aircraft used for elementary flying instruction under the Joint Air Training Plan.

mature pilots in thickly populated or highly developed areas are also involved, and the fact that the country is honeycombed with hedges renders any such descent dangerous for an airman and his aircraft. Narrow, winding roads often render difficult the location of aerodromes to the pilot unfamiliar with his own countryside, though these are an asset in concealing from the enemy his objectives.

Canada, however, offers facilities and opportunities unexcelled for the development of a programme that will achieve in the most expeditious manner possible the goal which the British Commonwealth has set for itself.

Canada's Greatest Contribution

Based, therefore, on the belief that Canada was peculiarly well adapted to make a great contribution in the air to the cause for which we have taken up arms, the Government of the United Kingdom approached Canada with a gigantic training scheme designed to provide the Royal Air Force with an ever increasing flow of highly trained air pilots, air observers and air gunners, whose arrival in the Mother Country would be coincident with the growth and expansion of England's aircraft industry and of her purchases abroad.

The plan was proposed not only to Canada, but to Australia and New Zealand, which, in addition to the United Kingdom, became partners in what is known as the British Commonwealth Air Training Plan.

Canada readily consented to place her vast territorial facilities, her financial and other resources at the disposal of the United Kingdom, and thus has accepted a project to which the Acting Deputy Minister of National Defence for Air, James S. Duncan, referred in a recent address as "Canada's Greatest Single Enterprise". To appreciate its magnitude one has but to remember that for investment and personnel it can be compared only with the railroad division of the Canadian Pacific Railway. The total cost of the project is estimated to be in excess of \$600,000,000, of which Canada's contribution will approximate \$350,000,000. A personnel of over 40,000 will be required to operate its various facilities. Large aerodromes are being developed from coast to coast and great depots are under construction for the repair and maintenance of a vast fleet of training aircraft. The one striking difference between the great railway system and the Joint Air Training Plan is that the Canadian Pacific has been the development of well over half a century, whereas the training plan speeds forward to full fruition in the next couple of years.

Schedules were established which were to bring the plan to its pre-determined capacity by the beginning of 1942, while, in the meantime, it turned out in progressively increasing quantities, pilots, air observers and air gunners as the months went by.

Plan Speeded Up

The events of the last few months in Europe, however, presented an emergency which has been met by the speeding up of the entire enterprise. Aerodromes scheduled for 1941 and 1942 have been added to this year's programme. The demand for immediate reinforcements has been met by sending aircrews to Europe. Squadrons have left and are going overseas, and pilots trained as instructors have gone to swell the ranks abroad.

Provision is being made for their replacement in order that the production

His Excellency Major-General the Earl of Athlone, K.G., P.C., G.C.B., G.M.M.G., G.C.V.O., D.S.O., Governor-General and Commander-in-Chief, paid a visit to Air Force Headquarters soon after his arrival in Ottawa. He discussed various phases of the British Commonwealth Air Training Plan with the Chief of the Air Staff, Air Commodore Lloyd S. Breadner, D.S.C., with whom he was photographed beside the table at which matters of policy are considered by members of the Air Council.

Photos by R.C.A.F.

of trained personnel under the British Commonwealth Air Training Plan may suffer as little as possible.

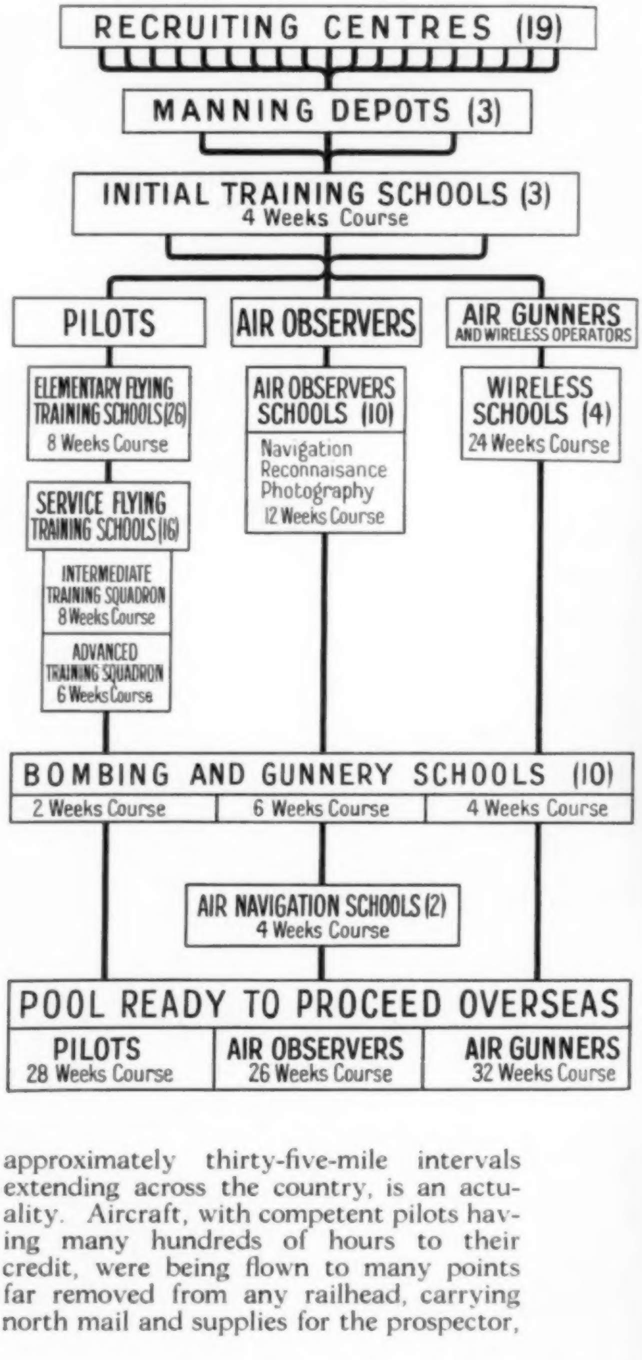
The contribution of the United Kingdom to the Joint Air Training Plan was to be the provision of aircraft and equipment for intermediate and advanced training. Aircraft and engines have been received. But the stream has been diverted, due to the urgent demand for all available aircraft to conquer the marauding mass of machines raised by the enslaved Nazi hordes to rain death and destruction on innocent women and children in addition to legitimate military objectives.

Many aircraft already received in Canada have been sent back to Britain, and others on the high seas, en route to this country, have been returned to swell fleets of the Royal Air Force. Provision has been made, however, to stimulate production in this Dominion, and to secure elsewhere an adequate supply of suitable training types.

Aviation had already revolutionized the physical and economic character of this and other countries when Canada declared war on Germany. The Trans-Canada Airway, with aerodromes at approximately thirty-five-mile intervals extending across the country, is an actuality. Aircraft, with competent pilots having many hundreds of hours to their credit, were being flown to many points far removed from any railhead, carrying north mail and supplies for the prospector,

BRITISH COMMONWEALTH AIR TRAINING PLAN

SEQUENCE OF TRAINING



The Air Force ensign flies from the roof of an embattlemented structure within the shadow of Parliament Hill. This is Air Force Headquarters, nerve centre of the British Commonwealth Air Training Plan.

Above:—Initial Training School at the Eglinton Hunt Club, Toronto, where pilots, air observers and air gunners receive preliminary instruction in Air Force subjects.

Left, top:—Instructor explains operation of a bomb sight at the Air Armament School, Trenton, Ontario.

Above:—Officers at the School of Aeronautical Engineering in Montreal learn maintenance problems and their solution.

Above:—Instruction in armament used aboard service aircraft at the Air Armament School, Trenton, Ontario.

Left:—Aero engine mechanics and airframe mechanics receive instruction in maintenance problems at the Technical Training School, St. Thomas, Ontario.

mine operator, trader and trapper. They were returning with gold and furs. Many of these pilots were immediately available for training as instructors at the Central Flying School.

Intensive Training Necessary

Canadians saw service and distinguished themselves during the last war in the Royal Naval Air Service, the Royal Flying Corps and the Royal Air Force, but since the Armistice of 1918 the majority have not actively participated in aviation, and so have not kept abreast of the tremendous changes which have resulted from the great technological progress that has taken place.

It is young men who are needed to-day to serve as aircrews of the fast and intricate service aircraft now employed; men who can withstand the physical strain, who can absorb the knowledge and technique demanded of them in a short space of time, and who have no pre-conceived ideas about training procedure. Methods employed are those prevailing in the Royal Air Force, and are considered to be the best in the world.

It is well known that the Royal Canadian Air Force has achieved its present degree of efficiency through trial and tribulation during the days of democratic disarmament. In those days, leaders in the Service at this time were enabled to attend the Royal Air Force Staff College and the Imperial Defence College. No effort was spared, with the limited financial resources at its disposal, to train personnel of the R.C.A.F. to face with confidence any national emergency that might arise.

So it was that, when a scheme for the training of pilots, air observers and air gunners was being considered here last autumn, Canadians were enabled to review all phases of the project in a sympathetic spirit. By reason of their familiarity with the R.A.F., and the fact that training methods in this country were modelled after those in the R.A.F., all instructional barriers disappeared so far as procedure was concerned.

It is unlikely that the services of those men who contributed to the creation of so high a reputation for Canadians as fliers in the last war can be utilized as pilots, air observers or air gunners. Those who have been engaged in commercial aviation may be suitable as instructors, and it is probable that others will be absorbed into the organization in some administrative or technical capacity. While young men are required for combat duty, and the Air Force is concentrating on the training of such material with the facilities now available, it is not proposed to discard the valuable experience of those who flew in the last war, provided their medical and other qualifications come up to the necessary standard set for entry to the R.C.A.F.

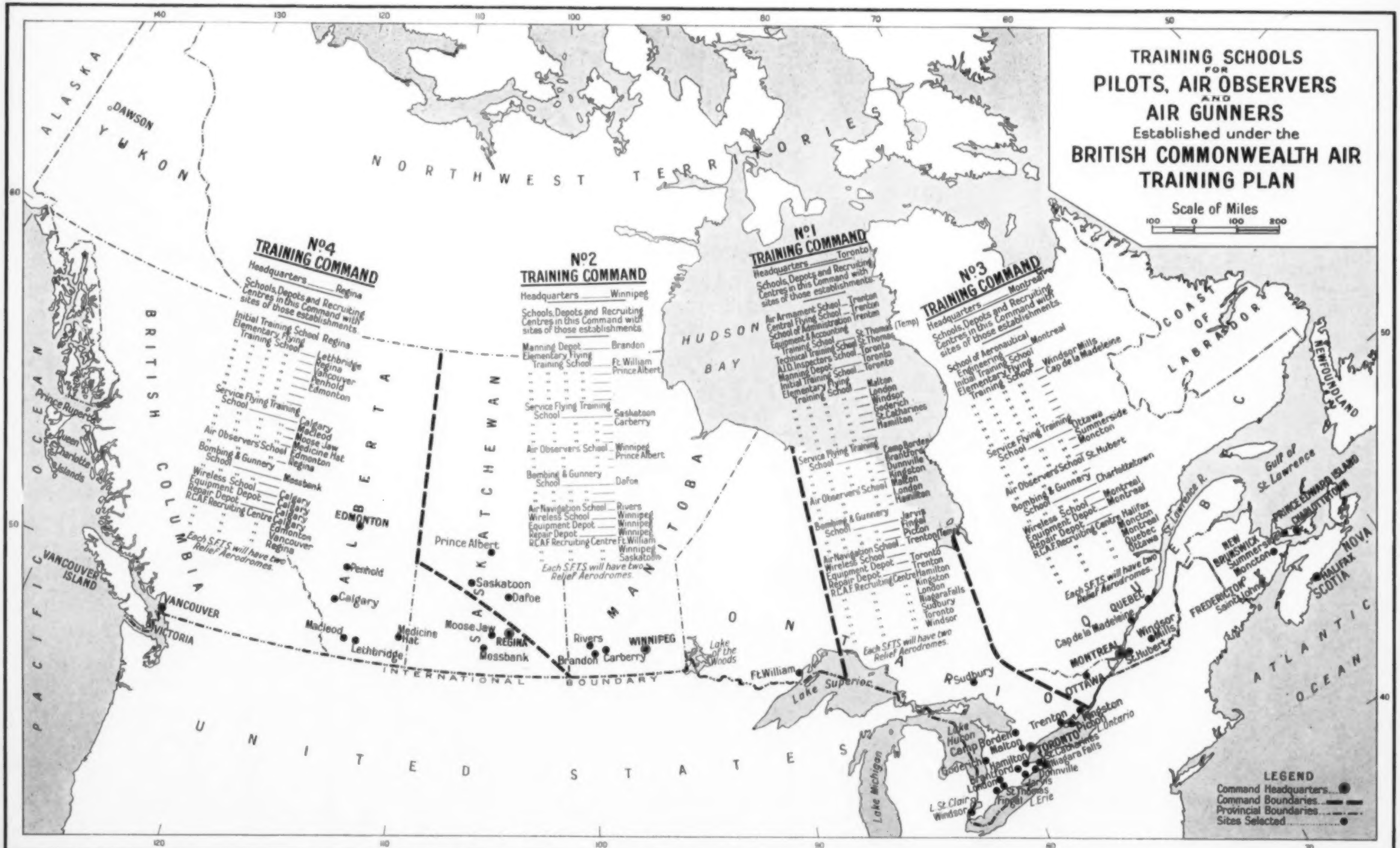
The principal factors that had to be taken into consideration when the scheme was undertaken were, briefly: Aerodromes, Buildings, Aircraft and Engines, Maintenance Crews, Administration, Instructional Staff and Students.

Huge Aerodrome Construction Undertaken

In detail, it was necessary to select suitable aerodrome sites. These had to be surveyed. Options on land had to be secured before the desired property was purchased. Development then commenced with stumping and grading operations. Provision had to be made for drainage and for runways. Fences had to be erected and provision be made for adequate protection against subversive elements. A watch tower is built at each main aerodrome, and provision is made for receipt of weather reports.

Advantage has been taken by the Canadian Government of the facilities of departments other than that over which

Early construction at the Service Flying Training School being established at the R.C.A.F. Station, Uplands, Ottawa.



TRAINING SCHOOLS FOR PILOTS, AIR OBSERVERS AND AIR GUNNERS
Established under the
BRITISH COMMONWEALTH AIR TRAINING PLAN
Scale of Miles
100 0 100 200
No 4 TRAINING COMMAND
Headquarters — Regina
Schools, Depots and Recruiting Centres in this Command with sites of those establishments
Initial Training School Regina
Elementary Flying Training School — Lethbridge
" " " " — Regina
" " " " — Vancouver
" " " " — Penhold
" " " " — Edmonton
Service Flying Training School — Calgary
" " " " — Macleod
" " " " — Moose Jaw
" " " " — Medicine Hat
Air Observers' School Edmonton
" " " — Regina
Bombing & Gunnery School — Mossbank
Wireless School — Calgary
Equipment Depot — Calgary
Repair Depot — Calgary
R.C.A.F. Recruiting Centre Calgary
" " " Edmonton
" " " Vancouver
" " " Regina
Each S.F.T.S. will have two Relief Aerodromes.
No 2 TRAINING COMMAND
Headquarters — Winnipeg
Schools, Depots and Recruiting Centres in this Command with sites of those establishments
Manning Depot — Brandon
Elementary Flying Training School — Ft. William
" " " " — Prince Albert
Service Flying Training School — Saskatoon
" " " " — Carberry
Air Observers School — Winnipeg
" " " — Prince Albert
Bombing & Gunnery School — Dafoe
Air Navigation School — Rivers
Wireless School — Winnipeg
Equipment Depot — Winnipeg
Repair Depot — Winnipeg
R.C.A.F. Recruiting Centre Ft. William
" " " Winnipeg
" " " Saskatoon
Each S.F.T.S. will have two Relief Aerodromes.
No 1 TRAINING COMMAND
Headquarters — Toronto
Schools, Depots and Recruiting Centres in this Command with sites of those establishments
Air Armament School — Trenton
Central Flying School — Trenton
School of Administration Trenton
Equipment & Accounting Training School St. Thomas (Temp)
Technical Training School St. Thomas
A.I.D. Inspectors School — Toronto
Manning Depot — Toronto
Initial Training School — Toronto
Elementary Flying Training School — Malton
" " " " — London
" " " " — Windsor
" " " " — Goderich
" " " " — St. Catharines
" " " " — Hamilton
Service Flying Training School — Camp Borden
" " " " — Brantford
" " " " — Dunnville
" " " " — Kingston
Air Observers' School — Malton
" " " — London
" " " — Hamilton
Bombing & Gunnery School — Jarvis
" " " — Fingal
" " " — Picton
" " " — Trenton (Temp)
Air Navigation School — Toronto
Wireless School — Trenton
Equipment Depot — Hamilton
Repair Depot — Kingston
R.C.A.F. Recruiting Centre London
" " " Niagara Falls
" " " Sudbury
" " " Toronto
" " " Windsor
Each S.F.T.S. will have two Relief Aerodromes.
No 3 TRAINING COMMAND
Headquarters — Montreal
Schools, Depots and Recruiting Centres in this Command with sites of those establishments
School of Aeronautical Engineering — Montreal
Initial Training School
Elementary Flying Training School — Windsor Mills
" " " " — Cap de la Madeleine
Service Flying Training School — Ottawa
" " " " — Summerside
" " " " — Moncton
Air Observers' School St. Hubert
Bombing & Gunnery School — Charlottetown
Wireless School — Montreal
Equipment Depot — Montreal
Repair Depot — Halifax
R.C.A.F. Recruiting Centre Moncton
" " " Montreal
" " " Quebec
" " " Ottawa
Each S.F.T.S. will have two Relief Aerodromes.
ALASKA
YUKON
DAWSON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
COAST OF LABRADOR
NEWFOUNDLAND
NEW BRUNSWICK
PRINCE EDWARD ISLAND
NOVA SCOTIA
HUDSON BAY
PACIFIC OCEAN
ATLANTIC OCEAN
UNITED STATES
INTERNATIONAL BOUNDARY
Prince Rupert
Queen Charlotte Islands
VANCOUVER ISLAND
VANCOUVER
VICTORIA
EDMONTON
Penhold
Calgary
Macleod
Lethbridge
Medicine Hat
Prince Albert
Saskatoon
Dafoe
Moose Jaw
REGINA
Mossbank
Rivers
Brandon
Carberry
WINNIPEG
Lake of the Woods
Ft. William
Lake Superior
Sudbury
Lake Michigan
Lake Huron
Camp Borden
Malton
TORONTO
Goderich
Hamilton
Brantford
London
St. Thomas
Fingal
Jarvis
Dunnville
St. Catharines
Niagara Falls
L. St. Clair
Windsor
L. Erie
L. Ontario
Trenton
Picton
Kingston
OTTAWA
MONTREAL
St. Hubert
Windsor Mills
Cap de la Madeleine
QUEBEC
St. Lawrence R.
Gulf of St. Lawrence
FREDERICTON
Saint John
Moncton
Summerside
CHARLOTTETOWN
HALIFAX
LEGEND
Command Headquarters
Command Boundaries
Provincial Boundaries
Sites Selected
140
130
120
110
100
90
80
70
60
50
40

presides the Minister of National Defence for Air, and organizations and associations that can contribute in some manner to the development of so vast a project. And, individuals with special qualifications or experience have been drafted for the purpose of assisting officers of the R.C.A.F. in the promotion of the plan.

The Department of Transport, for example, has contributed materially in the selection and development of aerodromes. The airways branch was in large part responsible for the creation of a Trans-Canada Airway, over which fly regularly the aircraft of Trans-Canada Air Lines. Experienced personnel were available to conduct preliminary surveys of the country, and to assist in the acquisition of property. Officers of the R.C.A.F. have accompanied all survey parties in order that the special requirements of the respective schools might be taken into consideration.

Factors governing the selection of sites for schools and the development of aerodromes are as follows:

(a) Equitable distribution as between Eastern and Western Canada, and within the various provinces.

(b) Cost of extending aerodromes now used by Trans-Canada Air Lines or established for some other purpose, as compared with that involved in the purchase and development of new sites.

(c) Relative importance of new capital expenditure as a permanent asset for the R.C.A.F., or the Dominion as a whole for civilian flying. In this respect, selection was partially governed by the possible utilization of such aerodromes on conclusion of the present conflict, and sites in proximity to centres of population have been chosen where practicable and economical. The desirability of providing the country with facilities for further development of civil flying is an important consideration.

(d) The proximity or otherwise of hazards to flying, and the character of the surrounding country have governed the suitability of sites for training schools of various kinds.

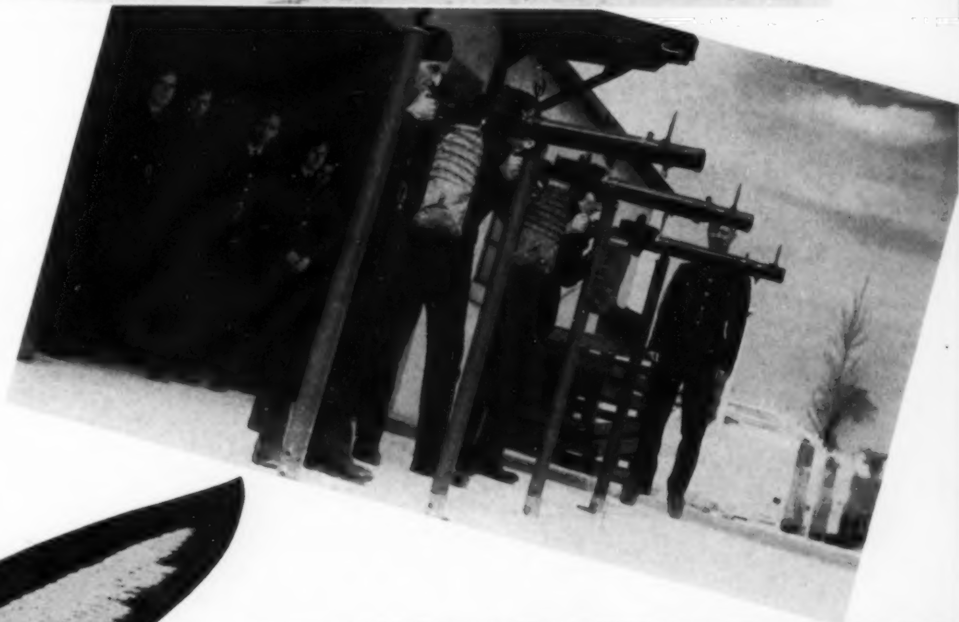
(e) The proximity of aerodrome sites to railroads and roadways, and the existence of communication facilities, such as telegraph and telephone services, and an adequate supply of electricity are further factors that had to be considered.

(f) The nature of the soil, and the cost of development as compared with that of another site on which less work would have to be done received attention. It was also necessary that a plentiful supply of labour should be available.

(g) In view of the fact that overhauls of aircraft and engines must be

School of Administration at Trenton provides administrative officers for some seventy schools for the training of aircrews, and for other R.C.A.F. units and formations.

Above:—Revolver instruction at the Air Armament School, Trenton, trains the eye and stimulates control.



Right:—Lewis gun practice on the twenty-five-yard range at Trenton.

Below: — Coveted "Air Gunner's Badge", awarded to the man who holds a very responsible position as a member of the aircrew of a twin-engined fighter or a bomber plane.

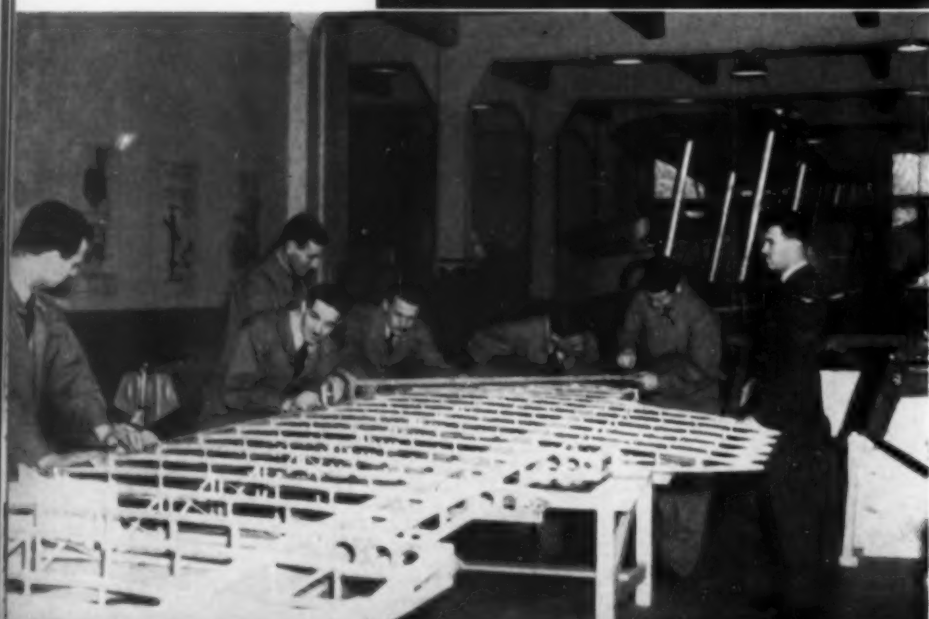
Above: — Twenty-five-yard range at Trenton, from behind the targets.

Left:—Machine gun practice on the twenty-five-yard range at Trenton, Ontario.

SCHOOL OF AERONAUTI
MONTRE

Instruction on a Bristol "Jupiter", engine provides information on radial engines for officers attending the School of Aeronautical Engineering in Montreal.

An aeroplane pontoon serves to provide instruction in sheet metal work at the School of Aeronautical Engineering in Montreal.



Working on ribs and spars of a "retired" aircraft in the School of Aeronautical Engineering, Montreal.

NAU TICAL ENGINEERING
ONT REAL

Practical instruction in the operation of aircraft engines, instruments, inertia starters, etc., is provided at St. Hubert Airport.

At work on the underside of a wing and the fuselage of a "retired" aircraft on the second storey of the School of Aeronautical Engineering in Montreal.

The famous Rolls-Royce engine, which powers many of Great Britain's and Canada's "fighter" aircraft, is assembled.

undertaken at periodic intervals, and repairs have to be made, the proximity of schools to aircraft and other plants has been considered desirable. The establishment of a repair depot in each of the training commands, which are nearly self-sufficient units, has rendered schools in the different areas less dependent on the aircraft factories, where prime consideration is now being given to the stimulation of aircraft production.

Through close co-operation between the Works and Buildings Directorate of the R.C.A.F. and the Royal Canadian Engineers, standard designs for structures at the numerous training schools have been prepared, specifications drawn up and the necessary number of blueprints and other drawings made available. On receipt of this material, with the necessary request that provision be made for the erection of buildings at a selected site, the Department of Munitions and Supply called for tenders and ultimately awarded contracts. Equipment and stores are also secured through the same department of the Government, on submission of requisitions by a large and important directorate of the Aeronautical Engineering and Supply Division of the R.C.A.F.

Standard designs were produced for some forty buildings required at the various schools. Blueprints and specifications had to be prepared, and tenders called. Some seven thousand blueprints and sixty sets of specifications were sent out for each school. After the estimates by interested contractors have been studied, contracts are let and construction begins.

Airmen trained in Canada since the outbreak of war embus in Ottawa for a port of embarkation, proceeding overseas on active service.

Provision must be made for heating, lighting, furnishing and the purchase of supplies.

Modern Planes for Training

Provision was made for the supply of certain types of aircraft and engines by the United Kingdom, and the assembly of the former in Canada. Other aircraft and engines were to be manufactured or imported from the United States for training purposes.

The types of aircraft stipulated are: Fleet "Finch" and de Havilland "Tiger Moth", for instruction at Elementary Flying Training Schools; Avro "Anson" and North American "Harvard", for the various types of pilot instruction at Service Flying Training Schools, while the Ansons will also be used at the Air Observers' Schools and the Air Navigation Schools; Fairey "Battle", for advanced flying instruction at the Service Flying Training Schools, for Bombing and Gunnery Schools and for the Air Armament School; and the Noorduyn "Norseman", designed and manufactured in Canada, for use at Wireless Schools and Air Navigation Schools. Some Norsemen are operated from floats in summer, which extends materially their field of action.

Other aircraft are also available, such as twin-engined Airspeed "Oxfords", Lockheed "Hudsons", Boeing transports, Douglas "Digbys", and the Westland "Lysanders", which are army co-operation aircraft.

Provision has to be made for the testing of such equipment, spare parts, overhauls and repairs. Consideration has also been given to the subject of replacements. The installation of armament in aircraft used for bombing and gunnery training, and wireless in those used for air navigation, and the instruction of operators are involved. Parachutes, fire-fighting equipment and

Part of the large number of air gunners and wireless operators (aircrew) under instruction at the Wireless School in Montreal.

refuelling arrangements are further factors that must be taken into consideration.

Maintenance is of prime importance. Prospective pilots, air observers and air gunners cannot be trained in aircraft that are not serviceable without endangering their lives. It is most necessary, therefore, that a corps of competent aero engine mechanics, airframe mechanics, fabric workers and metal workers should be made available. The Technical Training School at St. Thomas, Ontario, is the principal source of supply. Officers competent to take charge of maintenance operations are trained at the School of Aeronautical Engineering in Montreal. The Aircraft Inspectors' School in Toronto provides personnel for the inspection of aircraft in factories and repair depots.

Administration details of a project of such magnitude involve the provision of trained personnel in order that the machine may function efficiently. With such rapid expansion, it has been necessary to enlist the services of men from all walks of life to fill various administrative posts in the R.C.A.F. Civilians also are assisting in the promotion of the Plan.

The School of Administration at Trenton and the Equipment and Accounting Training School, temporarily at St. Thomas, are providing the necessary personnel for training purposes. General procedure in the Air Force, pay and allowances, Air Force Law, General and Daily Routine Orders and a number of other subjects are made familiar to officers at the School of Administration, while airmen learn how to handle equipment and stores, and secure an elementary knowledge of accounting procedure at St. Thomas.

Officers and N.C.O's. are being trained to assume the administrative responsibilities of the following seventy-one units at which will be trained pilots, air observers and air gunners, besides those of Air Force Headquarters, R.C.A.F. Training Commands, Stations, Units and schools for the training of instructors:

- Three Initial Training Schools
- Twenty-six Elementary Flying Training Schools
- Sixteen Service Flying Training Schools
- Ten Air Observers' Schools
- Ten Bombing and Gunnery Schools
- Four Wireless Schools
- Two Air Navigation Schools

Character of Aerodromes

To merely name these schools and the various units gives little idea of the extent of them. A Service Flying Training School, for instance, consists of a main aerodrome and two relief landing grounds within five to twenty-five miles of the central site, all of the same size. The main aerodrome has landing strips 3,000 feet long and 750 feet wide with two hard-surface runways, 2,500 feet long by 100 feet wide. The building area required at such schools is forty-five acres. There are sixteen of these Service Flying Training Schools in the Plan. One receives an idea of the extensive scale on which the Plan is based when one compares them with our modern commercial airports. These commercial airports meet the demands of modern commercial flying. Facilities are provided for handling aircraft operating on regular schedules, but they are totally inadequate

Left:—Air Vice-Marshal L.D.D. McKean, Chief Liaison Officer of the United Kingdom Air Liaison Mission, examines a new refuelling tender at Trenton, Ontario.

Below:—Hon. C. G. Power, Minister of National Defence for Air, and Air Vice-Marshal George M. Croil, Inspector General of the R.C.A.F., examine a refuelling tender at Ottawa.

James S. Duncan, Acting Deputy Minister of National Defence for Air (centre), discusses technical problems at the Technical Training School, St. Thomas, Ontario, with Air Commodore G. O. Johnson (right) and Group Captain D. C. M. Hume.

Above:—Air Vice-Marshal L.D.D. McKean, Chief Liaison Officer of the United Kingdom Air Liaison Mission, arrives at Trenton with Group Captain G. G. Banting, Liaison Officer for Training, and is met by Group Captain J. A. Sully, Commanding Officer of the Station.

Left:—Hon. C. G. Power, Minister of National Defence for Air, examines a Fairey "Battle", powered with a Rolls-Royce engine, in company with Air Vice-Marshal George M. Croil, Inspector General of the R.C.A.F.

Right:—Hon. Air Marshal W. A. Bishop, V.C., admires the graceful lines of a Supermarine "Spitfire", one of the most effective "fighter" aircraft in the R.A.F.

Below:—Pilot Officer M. D. MacBrien, son of the late Major-General Sir James MacBrien, receives his "wings" at the R.C.A.F. Station, Camp Borden.

Above:—Lieut. "Billy" Bishop, the keen-eyed Canadian with seventy-two air victories to his credit in 130 combats, inspects carefully the gun on which his life depended on many an occasion in the last great war.

Above:—Hon. Air Marshal W. A. Bishop, V.C., the legendary air force figure, talks to officers and airmen at the R.C.A.F. Station, Camp Borden, following a "Wings Presentation" ceremony.

Right: — Hon. Air Marshal W. A. Bishop chats for a moment during his inspection at Camp Borden.

Above:—"Wing" parade and after at the R.C.A.F. Station, Trenton, during which the Air Force ensign is raised and the salute is sounded. Upper photograph shows two of the barrack blocks and a hangar beyond the guard house.

for Service Flying Training Schools at which more than sixty planes are in constant operation at the same time.

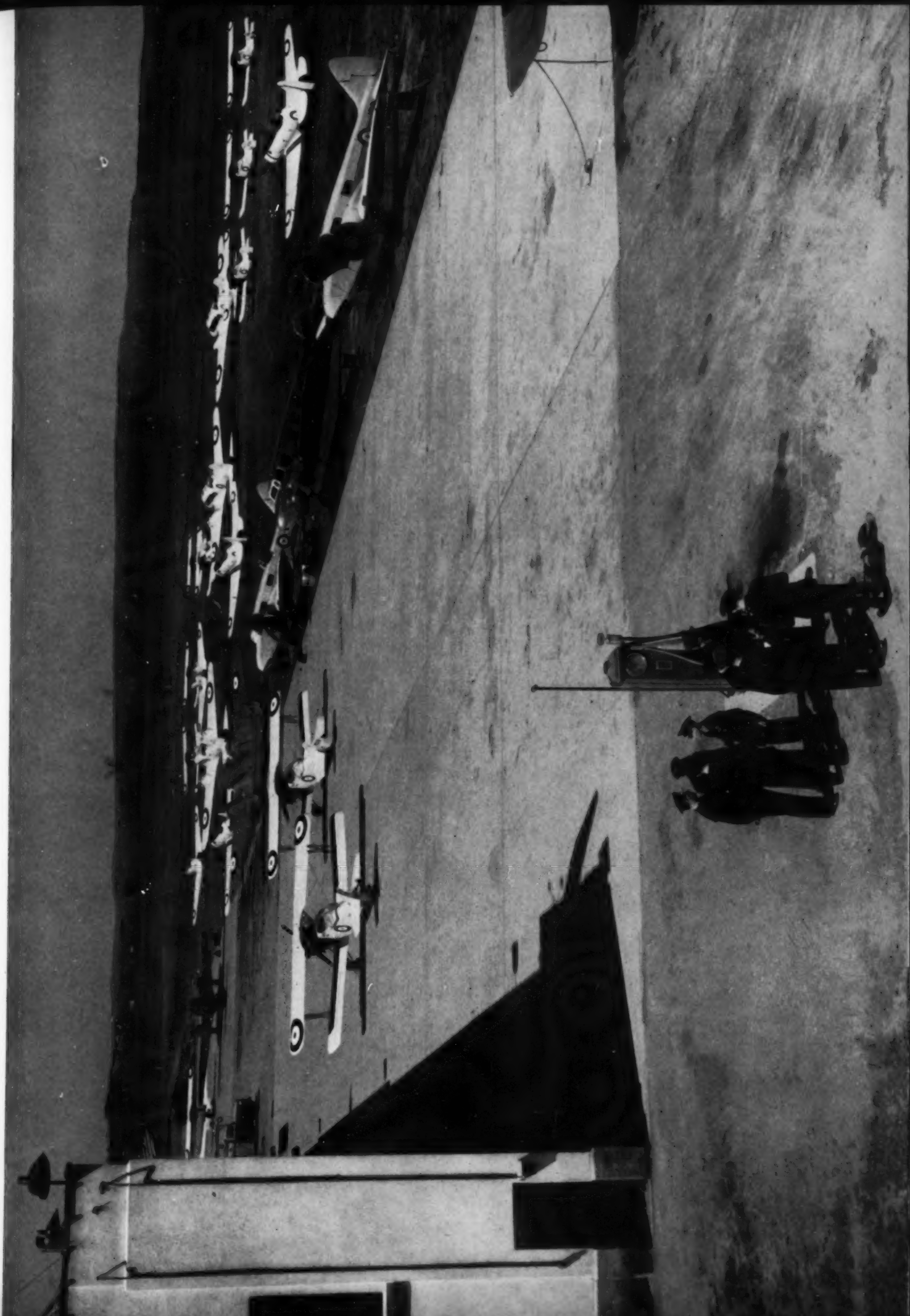
Instructors must be made available. No pilot, air observer or air gunner can expect to become proficient unless his training is obtained under the direction of a competent instructor. The Central Flying School at Trenton has already graduated a number of men qualified to act as instructors, some of these being "bush" pilots with many hundreds of hours in the air to their credit, but to whom the "training patter" was a foreign language. The Air Armament School, also at Trenton, has been training armament officers and armourer assistants who will be enabled to instruct student aircrew personnel in bombing and gunnery. The Air Navigation School at Trenton has been training officers to instruct air observers under the British Commonwealth Air Training Plan just as soon as they are ready to attend one of two Air Navigation Schools.

Photographic officers are in a similar category, as the air observer and the army co-operation pilot must have some knowledge of the air camera. Through the co-operation of the Royal Canadian Army Medical Corps and the Canadian Dental Corps, medical and dental facilities are made available to Air Force personnel. A School of Aviation Medicine, with headquarters in Ottawa, trains medical officers to meet the special requirements of the R.C.A.F. Research data now being compiled will enable authorities to assess the abilities of applicants, and to indicate whether a man would become a competent pilot, even before any expenditure on training was made.

Developing Aircrews

Finally, we come to the young man who has made application for enlistment in the R.C.A.F. as a pilot, air observer, wireless operator (aircrew) or air gunner. All other factors mentioned above must be taken into consideration before his application can be accepted. The recruit must be provided with a uniform and accommodation. He must be fed and given medical and dental treatment, when necessary. Messing is of vital importance, so provision must be made for a plentiful supply of good, wholesome food and efficient cooks to prepare the meals.

Right:—A few of the aircraft on the hangar apron at the R.C.A.F. Station, Trenton. These include Fleet "Finches", Airspeed "Oxfords", North American "Harvards", Lockheed "Hudsons", Fairey "Battles", and Avro "Ansons". Air Vice-Marshal L.D.D. McKean, Chief Liaison Officer of the United Kingdom Air Liaison Mission, and other senior officers discuss training and maintenance problems in the foreground.



The applicant will not necessarily be selected for training as a pilot, air observer or air gunner, though his choice of position will be considered. The results of his progress through an Initial Training School will determine the post for which he is best fitted.

All applicants must first visit one of nineteen Recruiting Centres throughout Canada, and subject themselves to an interview by the Officer Commanding, and to medical examination. The pilot must be between the ages of eighteen and twenty-eight, while the air observer, air gunner and wireless operator (aircrew) should be between the ages of eighteen and thirty-two. After acceptance, the recruit is posted to one of three Manning Depots at Toronto, Brandon and Ottawa. Thence he proceeds to an Initial Training School, one of which is now operating at Toronto and a second recently established in Regina, Saskatchewan.

At the Initial Training School the trainee really begins his school life and preparation for service in the air. The schedule takes a period of four weeks and the syllabus includes mathematics, accounts, armament, hygiene and sanitation, duties of an officer, drill and physical training, law and discipline, administration and organization. Mathematics syllabus, for instance, includes general revision of arithmetic, evaluation and transposition of simple formulae, simple equations, ratios and properties, etc. There are other subjects under the heading of hygiene and sanitation included. It is here, at the Initial Training School, that the Link Trainer is used to assist the staff in selecting potential pilots. The Link Trainer is a machine resembling a miniature aeroplane, but fixed to the ground. Instruments record the movements and the actions of pupils as though they were in a real aeroplane. Potential pilots are instructed in the Link Trainer for the co-ordination of mind and muscle and their reactions to normal flight movements are recorded. Those, of course, who possess in marked degree the qualities necessary for a pilot are so designated. Their performance at the Initial Training School governs to a material extent the selection of the course of instruction that a pupil should follow on graduation; either as a pilot, air observer or air gunner.

If selected for training as a pilot, the recruit will proceed to an Elementary Flying Training School for eight weeks, and thence to a Service Flying Training School for sixteen weeks. Eight weeks will be spent in an intermediate training squadron, six in an advanced training squadron and two at a Bombing and Gunnery School. The course, from the time he enters the Initial Training School, is of twenty-eight weeks duration.

If selected for training as an air observer, the recruit will go to an Air Observers' School for twelve weeks, to a Bombing and Gunnery School for six weeks and to an Air Navigation School for four weeks. The duration of his course is twenty-six weeks.

Should he be selected for training as an air gunner, the recruit will proceed to a Wireless School, the first of four now being in operation at Montreal. His course there lasts for twenty-four weeks, and he then goes to a Bombing and Gunnery School for a period of four weeks. The duration of his whole course is thirty-two weeks.

Many recruits will never attend an Initial Training School, of course, but will proceed from a Manning Depot to the Technical Training School. Their responsibilities as maintenance crews are of equal importance to those of the aircrews.

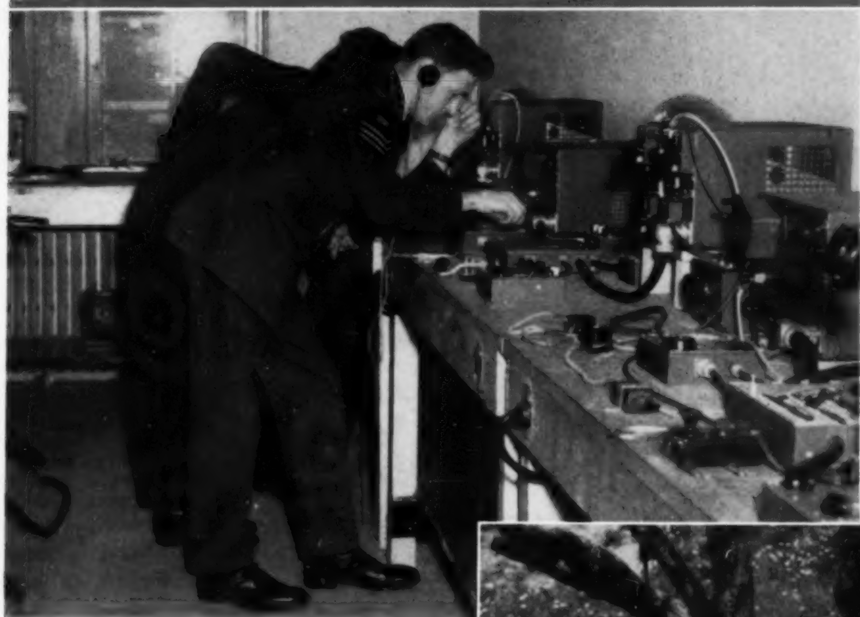
Co-operation of Civil Organizations

The Canadian Flying Clubs Association has contributed materially to the

Supermarine "Spitfire", one of the fighter-type aircraft now protecting Great Britain, which type will be flown by "fighter" pilots now training in Canada. At the left may be seen a Curtiss P-40, a fighter aircraft visiting Uplands Airport, Ottawa, from the United States. These two planes were flown together, and their characteristics compared.

Right:—Morse key instruction at the Wireless School in Montreal.

Left:—Wireless School in Montreal, which was formerly the Nazareth Institute for the Blind, provides instruction for air gunners and wireless operators (aircrew).



Left:—Prospective air gunners learn all the characteristics of radio equipment similar to that installed in aircraft. This equipment was designed by Canadian firms in conjunction with the R.C.A.F., and is in constant use at the Wireless School in Montreal.

Right:—Wireless operators at the Wireless School in Montreal receive signals from army cooperation aircraft, which are passed on to artillery commanders.

Top, centre:—Over 1,800 officers and airmen assembled at the first graduation ceremony at the Technical Training School, this being the largest turn-out in the history of the Air Force.

Below:—Air view of the mental institution costing some $7,000,000, which was turned over to the R.C.A.F. by the Ontario Government.

TECHNICAL TRAI

ST. THOMAS,

Nearly two thousand aero engine mechanics, airframe mechanics, fabric workers, sheet metal workers, instrument makers and other

Below, centre:—James S. Duncan, Acting Deputy Minister of National Defence for Air (in mufti) attends his initial Air Force ceremony at the Technical Training School, St. Thomas, in company with Air Commodore G. O. Johnson, Member of the Air Council for Organization and Training.

NING SCHOOL

ONTARIO

technical men are now being trained in this school, a definite quota being sent each week to R.C.A.F. units throughout Canada.

promotion of the Joint Air Training Plan, and particularly in its initial stages. Twenty-two flying clubs throughout the country were providing the elementary flying training for provisional pilot officers even before an agreement was signed between the commonwealth countries. A number of these pilots are now serving with Canada's Air Force Overseas. This form of training was continued until such time as the R.C.A.F. was in a position to supply facilities for the accommodation of personnel and aircraft at the Elementary Flying Training Schools. Through the joint efforts of the R.C.A.F. and executive members of the Canadian Flying Clubs Association, a plan was evolved whereby clubs or individual members of clubs might undertake the operation of such schools on a civilian basis. The aircraft, buildings, furnishings and barrack equipment are supplied by the Government, in addition to the aerodromes, and the incorporated training company is charged with the responsibility of providing instructional and maintenance personnel. Commercial aviation concerns have also been invited to operate Air Observers' Schools on a somewhat similar basis.

The Joint Air Training Plan is administered by the Government of Canada, while the organization and executive command of the training schools has been entrusted to the Royal Canadian Air Force. A Supervisory Board has been established for the general supervision of the plan, and meets at regular intervals. The Minister of National Defence for Air is chairman of the board. The members include the Minister of Finance, the Minister of Transport, representatives of the Government of the United Kingdom in the persons of the High Commissioner in Canada and the Chief Air Liaison Officer of the United Kingdom Air Liaison Mission, the High Commissioner of Australia and a representative of New Zea-

Building construction for the British Commonwealth Air Training Plan continued during the winter months. Upper photograph depicts scene in the drafting room at Ottawa, where thousands of drawings are prepared and specifications drawn up.

land, the Deputy Minister of National Defence for Air, and the Chief of the Air Staff.

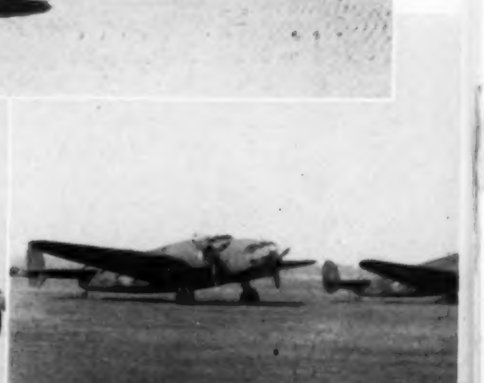
Canadians will comprise the vast majority of the personnel to be trained under the Joint Air Training Plan. Practically all air recruits in the United Kingdom will be trained at home. In Australia and New Zealand, all air recruits will receive their initial and elementary flying training at home, while most of the former and some of the latter will also receive advanced training in their respective countries. Under the agreement, however, about one-fifth of the pupils to receive advanced training in Canada will come from the other two Dominions. Some will be received from the United Kingdom, Newfoundland and elsewhere.

Within the limited compass of a magazine article, it is not possible to introduce and describe fully all the phases of a project of such magnitude and potentialities. The foregoing provides some conception of the ramifications of the Plan. Great progress has been made in every division, and the seedling tree that was planted late last autumn is now showing its leaves. Before a tree puts forth the full glory of its summer growth, it has presented a barren appearance. The multilimbed tree to which the British Commonwealth Air Training Plan may be compared was not dead during the past winter and spring months. Its roots, which were dug deep to weather any storm to come, continued to draw from many parts of the land nourishment that has enabled the tree to show buds. These buds are now bursting, and the tree is ready to spread forth its protective and operative greenery.

The Plan may also be compared to a coniferous tree with needles; needles that, in the case of this project, may be expected eventually to prick the balloon of German and Italian ambitions, and to bring peace and prosperity once more to a stricken world.

Construction scenes at some of the schools being established throughout Canada under the British Commonwealth Air Training Plan. Upper photograph shows hangar of Repair Depot now complete at Trenton. Bottom photograph illustrates watch tower at Camp Borden.

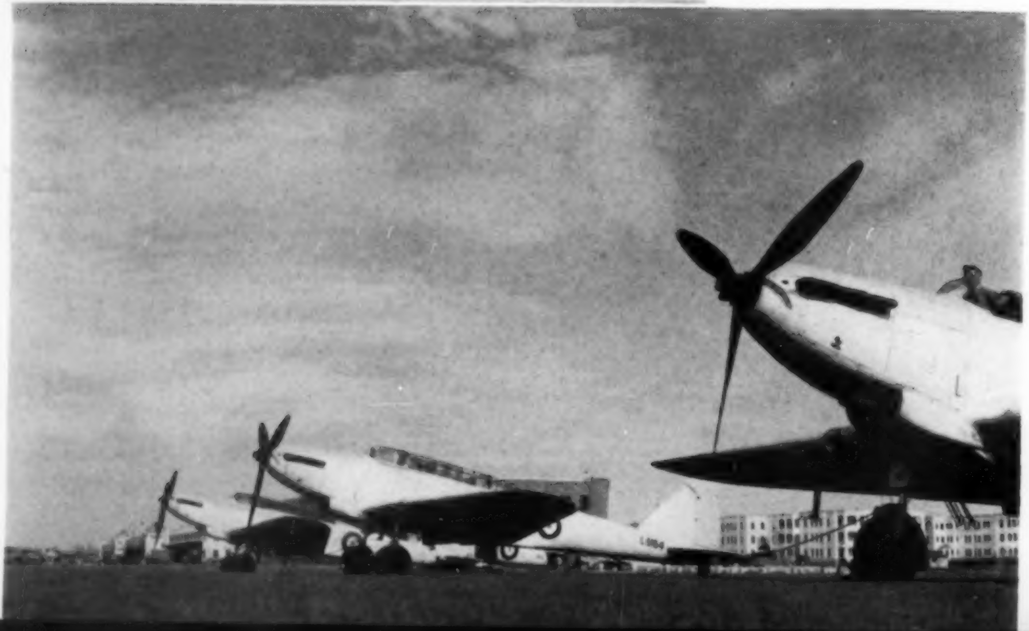
Aircraft in operation with the Royal Canadian Air Force, a number of which are being used for the instruction of aircrews under the British Commonwealth Air Training Plan, identified as follows: Top Row (left to right) —Supermarine "Stranraer", Avro "Anson" and Westland "Lysander". Second



Row (left to right)—Fairey "Battle", North American "Harvards" and Blackburn "Shark", with wings folded. Third Row (left to right)—Douglas "Digby", the largest type of aircraft in the R.C.A.F., and Northrup "Delta". Fourth Row (left to right)—Airspeed "Oxford", line of Lockheed "Hudsons" and Fairey "Battle", being refuelled.

ght:—Fairey "Battle"
om the United King-
om being unloaded at
e R.C.A.F. Station,
amp Borden, after be-
ing uncrated.

Left: — Fairey "Battle" being assembled at the R.C.A.F. Station, Trenton, after being removed from one of the crates beyond.



Fairey "Battles" on the
aerodrome at the
R.C.A.F. Station, Tren-
ton, ready for training
exercises after arriving
from the United King-
dom.

Rubber Plantations of Asia

by JOHN HOCKIN

THE Para rubber tree, from the milky juice of which commercial rubber is derived, is a native of the Amazon Valley in South America, and the 4,000,000 acres of rubber trees now growing in Malaya, Ceylon and the Netherlands East Indies owe their existence to the resource of Sir Henry Wickham, the man who succeeded in bringing seeds alive from Brazil to London sixty-three years ago. Those seeds were successfully germinated and the plants shipped to Ceylon and Malaya to found one of the largest and most important agricultural industries in the world.

Calcutta had been the site originally chosen for experimental planting of the Para rubber, but stunted growth soon proved that the climate of northern India was unsuitable. In the southern lowlands of Ceylon, where the temperature rarely falls below seventy degrees Fahrenheit and the rainfall approximates to 100 inches a year, conditions were ideal, and no difficulty was experienced in rearing the young trees. Within five years large quantities of seed had been distributed to Malaya, Java and Sumatra, territories where the climate is very similar to that of Ceylon. Later the trees were tried at higher elevations up to 2,000 feet, but it was found that at the lower temperatures prevailing, the yield of rubber was less and the trees were more liable to disease. As a result, there is to-day only a small acreage of rubber in the East growing above 1,000 feet.

In the early years planting was slowed up by doubts of the economic future of rubber. It needed the stimulus of the boom resulting from the birth of the motor-car, which culminated in the price of rubber reaching $3.12 a pound in New York in April, 1910, to encourage planting on a big scale. By 1915 the acreage of rubber in the East had been trebled; planting at a less feverish rate has been going on ever since. Meanwhile, progress in research has taught the rubber planter to improve enormously on the methods of cultivation and manufacture employed twenty years ago.

The Para rubber grows on a plantation to a height of fifty feet and can attain a girth of eight to ten feet. It is planted in rows, and the foliage, which is not very abundant, is composed of large three-lobed leaves of dark, shiny green, which are shed during the wintering period of February to March. The flowers are in inconspicuous sprays, and the mottled brown and cream seeds, produced just before wintering, are encased in threes in shells which dry and burst, projecting the seeds as far as fifty yards from the base of the tree. Most rubber planters' bungalows are roofed with sheets of tin, and there is no need for the occupants to watch the trees to know when seeding begins — staccato reports as the seeds hit the roof, and the rattle as they roll off, promptly supply that information.

The milky juice, or latex, as it is called, is obtained from the trunk of the tree by a process known as tapping. When the rubber trees first planted in the East had attained sufficient growth after five years to make tapping practicable, experiments were undertaken to determine the method that, while giving the highest yield of liquid rubber, would cause least injury to the trees. These experiments were continued for many years, and what is generally agreed as the best method has been evolved. It consists of shaving off thin layers from a sloping groove cut into the bark of the tree and extending halfway round the circumference of the trunk.

This is done with a sharp knife of special design, the greatest care being taken to avoid cutting right through the bark and injuring the live layer underneath. Only the thinnest layer must be removed at each tapping, and the great skill required can be appreciated from the

Tappers bringing latex to the factory.
Courtesy Rubber Growers Association

fact that the consumption of bark should not exceed an inch a month of fifteen tappings. At the end of the season the groove on one side of the tree is left to enable the thin layer of bark left above it to renew to normal thickness, and a groove is opened on the other side. The health and vigour of a tree can be gauged from the speed with which bark renewal takes place, and the future value of the tree depends upon the care with which the tapping has been done. Each wound into the living layer beneath the bark causes the tree to throw out a knot; if, as is often seen on small native estates in the villages of Ceylon and Malaya, too many of these knots are formed, the tree becomes impossible to tap and is only fit for firewood.

The removal of the layer of bark opens the latex cells and the liquid rubber oozes out, collects in the groove and flows down it into a half coco-nut shell fixed to receive it. The yield of latex varies greatly from tree to tree due not so much to the soil (and not at all to the size of the tree) as to the yielding properties inherent in certain trees. Lack of natural plant food, or its equivalent in chemical manure, will decrease the yield of any tree, but under conditions of careful cultivation, it is found that though all the trees may be in the same state of vigour, some still yield more than others. From this interesting fact has been developed the modern system of bud-grafting which will be described later in this article.

A native tapper, between sunrise and 10 a.m., the time of day when the latex is yielded most freely, will open the latex cells on 200-300 trees. When the tapping is completed, he collects the latex by emptying the coco-nut shells into a bucket, and takes this to a central depot from where it is transported by bullock cart or motor lorry to the factory. The tapper is paid by the amount of latex he brings, and can earn up to the equivalent of thirty cents a day which is good pay for agricultural labour in the East.

At the factory the latex is strained to remove dirt, is poured into jars or tanks, diluted with water to a uniform composition, and acid is added to it in exact proportion to hasten its coagulation. The next morning the coagulum is cut out of the tanks in slabs of convenient thickness,

Indian Tamil tapping on a modern Ceylon plantation.
Photo by author

Self-sown rubber on a plantation in Java.

Courtesy Rubber Growers Association

looking exactly like huge chunks of marshmallow, and taken to the rolling machines, through which it is mangled out into sheets an eighth of an inch thick. These are then taken to the smoke-house and kept there to dry in an atmosphere thick with wood smoke at a fixed temperature for nine or ten days. From the smoke the rubber absorbs antiseptics against mould, and during drying the sheets turn translucent golden brown. For other forms of rubber, such as the crepe used for the soles of shoes, the process of the rolling and drying is modified according to requirements, but any one process is carefully systematized, and the system must be rigidly adhered to, to maintain even quality in the finished rubber.

Work on rubber plantations is not confined to tapping and manufacturing the rubber. Weeding to keep out noxious jungle growths, draining, building a stone terrace around each tree on steep land to prevent soil erosion, repairs to roads, anti-pest work, manuring—all this has to be carefully attended to if the rubber plantation is to increase its earning capacity. In addition, there is the bud-grafting mentioned above.

This, the latest development in rubber research, promises to revolutionize the whole industry. The yield of rubber for the three main producing countries averages 500 pounds of dry, manufactured rubber an acre of trees, and a yield of 800 pounds an acre from even a few trees is considered exceptional. By grafting buds from trees specially selected for their high yielding properties on to plants raised from seed in the normal way, it has been found possible to increase the output of rubber from a given acreage to twice, three times, and even four times this figure. Occasionally yields up to 3,000 pounds an acre have been reported from experimental tappings of small blocks.

The process of grafting on the bud is similar to the methods employed for grafting rose or fruit trees. The shoot growing from the grafted bud is the only growth permitted, other shoots being removed. In course of time the shoot becomes the trunk of the tree, and the junction, seen as a heel when the tree is young, gradually straightens out.

So promising are the results obtained from this method of propagating rubber

Modern rubber planter's bungalow.

Courtesy Remfield Rubber Co.

that no planting is now done in the old way with unselected seedlings, and plantations are now cutting out their old rubber to re-plant with budded trees.

This re-planting is being done on the contour system, which results in the minimum wash of soil during heavy rain. In past years, Malaya, Ceylon, and, to a less extent, the Dutch East Indies have lost millions of tons of irreplaceable humus by the carelessness of planters in failing to combat soil erosion. So seriously has this denuded the soil that large applications of costly artificial manure are now necessary to keep the rubber trees supplied with food. To prevent further denudation the planting of the rubber on these contour platforms, which act as traps for the soil washed down from above, is being carried out, and low-growing cover-crops are also being planted under the rubber for the same purpose.

The felling of the old rubber on many plantations is done cheaply with elephants, which can be hired for $5.00 a day, and will push over a hundred trees a day with ease. This work, at which they excel, gives the elephants opportunities to display their well-known sagacity. For instance, if the side-roots of a tree have not been properly cut through with axes before they are brought up to push it over, their trunks will go up and, after a preliminary push, the animals will back away, firmly declining to exert themselves further until the necessary cutting has been done. If there is a large tree with its tap-root so firmly wedged between rocks that no pushing will move it, a second elephant will be made to pull on a rope attached to a top branch while the first shoves against the trunk with all the strength of his four tons of bone and muscle. The two elephants, under the noisy direction of their mahouts, work together splendidly, and the tree soon crashes down in a cloud of flying leaves and fragments of branches.

Nearly half the acreage of rubber in the East is in the hands of native owners,

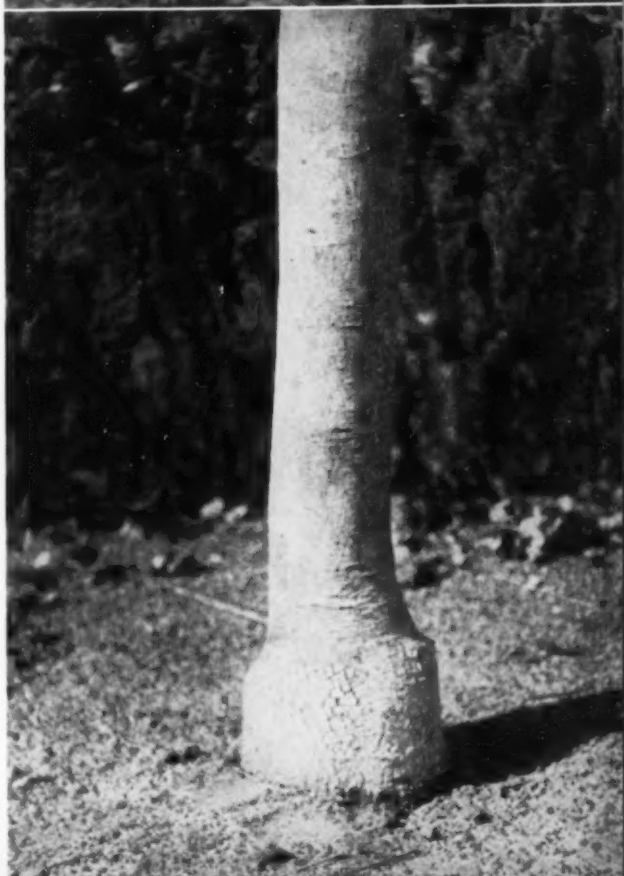
Sinhalese, Malays, Chinese and Javanese, in small plantations of 100 acres and less. The rest is owned by British, American and Dutch companies. These plantations average 1,500 acres, and each one employs a manager, several assistants who are British or Dutch, a staff of a dozen native clerks and overseers, and a labour force numbering 300-400. On Ceylon and Malayan rubber plantations the labour force is mainly made up of Tamils from South India, many of whom emigrated to the two countries in the early planting days and their descendants have remained ever since. New recruits can also be obtained as required through the organization set up in southern India by the planters many years ago.

The Indian Tamil is more suited by temperament for plantation life than the more independent and intelligent Sinhalese and Malays. The Tamil coolies live in tenement houses, called lines, four people occupying a room twelve feet square and the part of the veranda outside it. The lines are erected by the plantations and are well built of stone and roofed with tiles, or tin, or thatch. In comparison with the huts found in the south Indian villages, the living quarters of the coolies in Ceylon and Malaya can only be described as luxurious.

The Tamil coolies are well looked after in other ways. They receive free medical attention and most plantations have their own hospitals. There are schools for the children and pensions for the aged. The communal life of a plantation suits the Tamils, and few forsake it for the hardships of life in the Indian villages.

For certain highly skilled work Sinhalese and Malays are invaluable, and a fair number are employed in this way. In the Dutch East Indies the labour is Javanese, a people who require more careful handling than Tamils and cannot be relied on to the same extent.

The clerks and overseers are of various nationalities and, though European supervision is essential to keep them hard-working and honest, they have played an important part in building up the industry. A clerk



Top:—Bud-grafted rubber plant a few weeks after grafting.

Right:—The same, three years later. The shoot has grown into the trunk of the tree and the junction is straightening out.

Photos by author

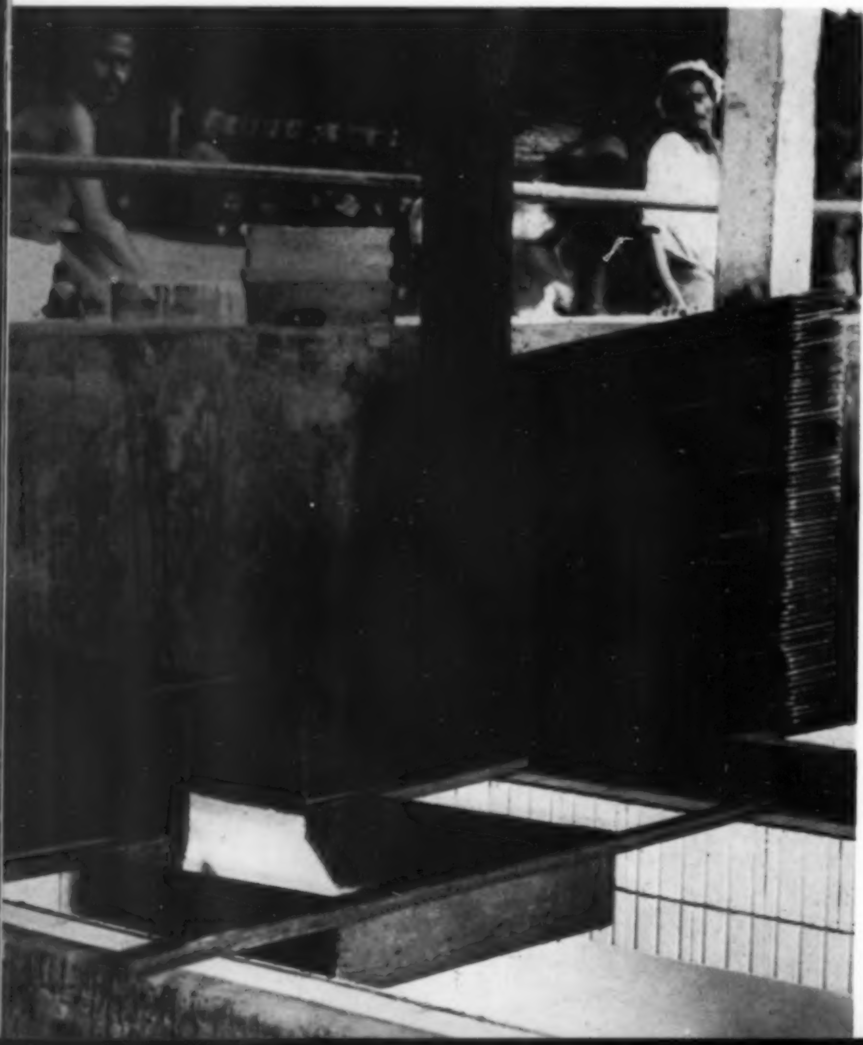
or overseer nowadays may draw up to $50.00 a month, in addition to which he is given free housing on the plantation.

During the last twenty-five years of progress in the cultivation of rubber, equal progress has taken place in the conditions of life for European planters. In place of the unhealthy, mud-walled, grass-roofed shacks inhabited in the early days, planters now live in well-built bungalows with electric light and running water. The plantations are well roaded, and a car or motor-cycle is as necessary for the rubber planter of to-day as a horse was for his predecessor in 1910.

The responsibility carried by the manager of an estate is heavy. In addition to supervising in field and factory, he has an office to organize and many odd jobs to do. It used to be said that a successful rubber planter must be a first-class organizer, an accountant, an engineer, a doctor, a farmer, a surveyor and a scientist all in one, and there is still much truth in this to-day.

Salaries for rubber planters are dependent upon the prosperity of rubber, a product that throughout its commercial history has been subject to violent fluctuations in price. An average salary for a manager of a 1,500-acre plantation at present would be $500.00 a month. In addition, his bungalow is free, and he is paid his passage to Europe and six months' pay every four years. Against this the climate makes it essential for him to retire soon after fifty and, if he is married, he will have to face heavy expenses sending his family "Up-Country" during the hot season and his children to Europe to be educated when they are five years old.

In the whole of the East there are only 4,000 or so European planters. But between them they employ not less than half a million labourers — final proof of the economic importance of the huge industry that has been built up by a quarter of a century of European and American enterprise.



Emptying latex into coagulating tanks.

Courtesy Rubber Growers Association

Rubber And Its Manufacture In Canada

by **ARTHUR L. NEAL**

ONE afternoon, about the year 1770, the English natural philosopher, Joseph Priestly, sat crouched over the writing table in the neat and well-ordered study of his home in Leeds. He was engaged in writing his treatise on "The Theory and Practice of Perspective". It was an arduous task. The words, laboriously pencilled out in long-hand, did not flow easily. Often a phrase once set down did not seem just right. Corrections were frequent, but Priestly's manuscript did not bear the marks of many revisions. Somewhere he had obtained a bit of a peculiar, heavy, black, doughy substance that had been brought to Europe from the tropics as a curiosity. Priestly found that this material could be used to rub out pencil marks. This use devised by him gave to the substance the name "rubber", which is used to-day wherever the English language is spoken.

Christopher Columbus is said to have been the first white man to become acquainted with rubber. It is related that on the occasion of his second voyage to America — 1493-96 — he witnessed a game played by the inhabitants of Hayti using balls prepared from the gum of a tree, although the story is open to question since there is no rubber-producing tree or shrub indigenous to Hayti. It is certain, however, that Spanish explorers found rubber in Mexico about 1521, and saw it being used by the natives in various ways. Over 200 years later the Portuguese missionaries found the natives in the region of the Amazon Valley using rubber to make crude articles of clothing, shoes, headgear, torches, and other useful items.

But the civilized world was slow in learning to make use of rubber. During more than two centuries after rubber was first brought to the attention of Europeans, it was regarded only as a curiosity and was given no serious consideration from a commercial viewpoint. As late as 1791 James Anderson was able to write in an article in the *Edinburgh Bee*:—

"It is easy to see that the uses to which this substance might be applied in arts and manufactures are innumerable, and as such can be effected by no other known substance in nature. Yet so blind have mankind hitherto been to these advantages . . . all that has been done is, to suffer the natives to mould it into the form of a small kind of bottle . . . and these, when brought to Europe, are applied to scarcely any other use than being cut to pieces for the purpose of effacing marks made upon paper by a black lead pencil, or that of idly amusing children by stretching it out and observing how perfectly it again recovers its pristine form."

Rubber Industry is Peculiar to the Modern Era

Rubber is peculiarly a commodity of the modern industrial era. The great expansion in its use has occurred within the last generation, and most of the uses to which it is now put were unknown fifty years ago. In 1887, just before the invention of the pneumatic tire by J. B. Dunlop, the gross export of rubber from producing countries was estimated at 17,280 tons, of which from one-quarter to one-third was dirt and impurities. Thirteen years later, in 1900, the supply had reached 40,000 tons of clean rubber; and a small quantity of plantation rubber — four tons — appeared for the first time in London as a marketable product. There followed a period of spectacular growth in the rubber trade, until 1929 when shipments from producing countries reached 867,900 tons. Then the industry felt the severity of the world economic depression, and the almost continuous growth in the consumption of rubber suffered an interruption. Recovery re-established the upward trend and carried it to new high levels. World consumption is estimated at 1,075,000 tons in 1939.

Uses and Applications

To-day more than fifty thousand different products of rubber are marketed

Curing a heat vented two-tread tire in the individual vulcanizer.

Courtesy Seiberling Rubber Company of Canada, Limited

to contribute to human comfort, health and pleasure. It is used for such unrelated products as automobile inner tubes and tire casings, refrigerant hose, artificial flowers, nursing bottle nipples, electrical insulation, footwear, surgeons' gloves, mattresses and cushions, golf and tennis balls, adhesive tape, rubber bands, floor coverings, and telephone receivers. These varied uses bear witness both to the versatile qualities and properties of the material and to the adaptiveness and technical skill of the modern rubber industry.

By skilful compounding with other materials the properties of rubber may be varied to meet a great diversity of conditions and uses. Probably the outstanding property obtained is resistance to abrasive wear. This, along with resilience, has made rubber the indispensable ingredient in the manufacture of tires. About three-quarters of the world's consumption of crude rubber is used in the tire industry. Resistance to abrasive wear is also important in the manufacture of rubber heels and soles and the construction of conveyor belts for carrying ore, sand, gravel, coal, and other materials. At the Grand Coulee Dam in the United States there is a conveyor belt two miles long which is said to transport 48,000 tons of crushed rock each day.

Flexibility, combined with other desirable properties, renders rubber superior to other materials for many articles of everyday use, e.g., mattresses, upholstery, and cushions made from whipped and moulded latex (i.e. liquid rubber) are achieving increasing popularity; no less than 500,000 units of this material being in use in Canada. With their superior cushioning qualities and comparative lack of weight and bulk, and the advantages they offer by being vermin-proof, a market of vast potentialities is now being tapped.

Extensibility of rubber has been utilized as the characteristic property of stationers' bands and in elastic webbing. Resilience and the power to absorb shock is a quality which is put to use in many rubber articles such as tires, shock-absorber cord, shackles for automobiles, heels and soles, and many others. There is no other material that will so effectively absorb energy and at the same time regain its original form. The day is not far when all vibrating machinery will be mounted upon rubber, thus prolonging the life of the structures which house such machinery, and the life of the machinery itself.

Rubber is a non-conductor of electricity. This, combined with its flexibility, makes it an ideal insulation for electric wire and cable. There has recently been developed a rubber which is electricity-conducting. An aeroplane equipped with tires of this material has the advantage that any static electricity which the machine may have gathered in flight is discharged in one one-thousandth of a second after the tires touch the ground. On dry surfaces rubber exhibits an enormously high frictional resistance. Advantage is taken of this property in rubber transmission belting which transmits power satisfactorily under many conditions where leather belting cannot be used. It would be tedious to enumerate many further examples of the useful application of the versatile properties of this material, but no description of rubber could be adequate without reference to its waterproofing properties. This strange and highly valuable quality of being able to resist water has long been one of rubber's main claims to fame, and it is believed that the earliest use of the substance by human beings was in the form of waterproof clothing.

THE WORLD INDUSTRY
Early Development

The rubber industry really dates only from 1819 when the manufacture of rubber goods was begun in England. It was 1832 before it came to America.

One of the early pioneers was Charles Macintosh, a chemist of Glasgow. It was he who discovered that it is possible to dissolve crude rubber in coal-tar naphtha. This led to the beginning of the rubber-proofing trade in much the form it retains to-day. Previously, other solvents of rubber were known but they were either inefficient or too expensive to be practicable. In 1832 Macintosh obtained a patent for rendering fabrics waterproof. He spread a solution of rubber on the surface and joined two coated pieces in a double waterproof texture. The raincoat which he developed was not serviceable because of the poor resistance of unvulcanized rubber to climatic changes in temperature. Nevertheless it achieved wide popularity profitable to the Scots chemist. Macintosh made many other things of rubber, but the waterproof coat was the one that made his name live.

Thomas Hancock, another great name in the history of rubber, was a contemporary of Macintosh. During the period 1820-48 he obtained no less than sixteen patents dealing with the processing of rubber. Hancock was, however, much more than a pioneer in technical development. What is probably his most important contribution was the fact that he established manufacturing organizations for the production of goods in accordance with his ideas. Although the history of the industry is not entirely clear on the subject, it appears that the first successful solid rubber tire was invented by Hancock. The companies of Hancock and Macintosh were consolidated in 1830, and it is certain they were producing a solid rubber tire as early as 1846.

Vulcanization

In 1839, in the kitchen of a humble home in Woburn, Massachusetts, there happened an event that changed and affected the whole subsequent development of rubber processing. It was there that Charles Goodyear, after years of discouraging experimentation, discovered that

Building of bus balloons on undercut drum.
Courtesy Seiberling Rubber Company of Canada, Limited

by mixing rubber and sulphur and applying heat there occurred a change that would free the rubber producer from most of the troublesome disabilities of his material. Thus, the technique of "vulcanization" became known, and practically all the rubber goods that are now made come within the scope of Goodyear's discovery.

Prior to this discovery the rubber industry was small and struggling. Rubber was used principally because it was flexible and waterproof; it could be plasticized and shaped, but only by impairing other important properties. Useful and merchantable goods could not be produced because the rubber became unmanageably stiff in winter, while the heat of summer converted it to a sticky mass. If articles requiring both strength and stretch were needed they were cut from selected pieces of the crude material. The products were, in general, of short life and low durability, and of limited utility because they were so highly sensitive to changes in temperature. The discovery of vulcanization made it possible to use the plastic properties of rubber to bring it to a desired shape and to convert it to a harder, tougher, and more permanent material. By this invention, the manufacturer was liberated from a troublesome restriction as to raw material and process, and was enabled to make products better suited to nearly every purpose to which the use of rubber is applied. To mankind there was made available a material so abounding in useful properties that, after one hundred years of constant development, its many applications are still increasing.

Plantation Rubber

In 1875, rubber plants were acclimatized in the East. This was not of great immediate practical importance and met with little success until the development of the bicycle and motor vehicle. When viewed in the light of subsequent developments it assumes far-reaching significance in that by the time the motor-car came into common usage an adequate supply of crude rubber had been established. By 1910 the production of plantation rubber had surpassed the wild production of Brazil. At present, practically all the supply of rubber comes from the plantations described by Mr. Hockin in this issue, and the total potential world production has grown to around 1,500,000 tons per year.

Effect of Motor Transport

It has been stated above that about three-quarters of the world's consumption of rubber is absorbed in the manufacture of tires. The earliest known pneumatic tire was patented in England by Robert W. Thompson in 1845. Solid rubber tires had already been in use. Thompson's tire did not bear commercial results, although a set of them is reported as "having been run for 1,200 miles without the slightest symptoms of deterioration or decay". A later and independent invention of a pneumatic tire was patented by J. B. Dunlop, of Belfast, in 1888. Dunlop's tire became a commercial success because the bicycle needed it. The rapid increase in the use of bicycles and tricycles which followed his invention proved a dominant force in advancing the use of rubber tires. Its still greater future use on motor vehicles was fore-shadowed in 1895 when a car, equipped with pneumatic rubber tires, competed in the Bordeaux-Paris trials. The advent and development of the motor-car revolutionized the rubber industry. The tremendous impetus which it gave to the demand for rubber tires not only made possible the successful development of plantation rubber growing, but also transformed rubber manufacturing

Right:—Dieing out uppers for fabric rubber-soled footwear.

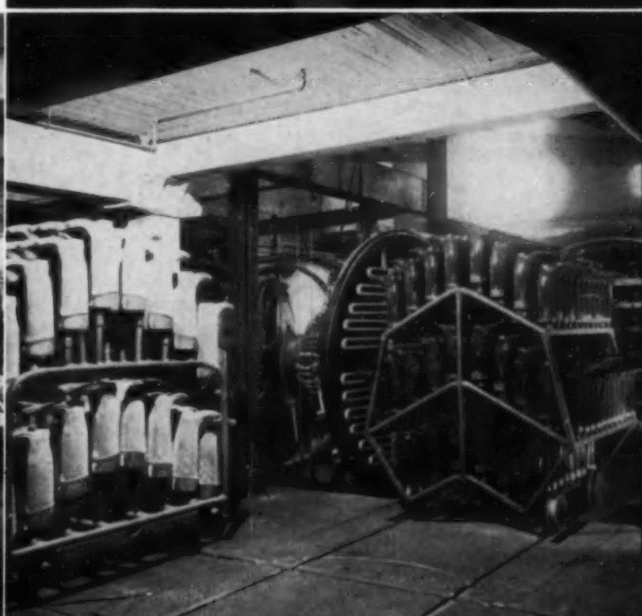
from small-scale struggling enterprises to giant industries, largely international in scope.

While the importance of the tire has been rightly emphasized, the modern motor-car includes more than two hundred other items of rubber, such as radiator hose, fan belts, engine mountings, floor-mats, running-board covers, and seat cushions. These in the aggregate comprise nearly as many pounds of rubber as do the tires.

The Present Status

The world's demand for rubber has converted tropical jungles of the East Indies into cultivated plantations. Four million persons over all the earth are employed in the rubber business. These, with their dependants, constitute a population in excess of that of the Dominion of Canada. Facilities for the growing, manufacture, and distribution of rubber represent a capital investment roughly approximating the Canadian national debt (at something over $3,000,000,000). The world's output of manufactured products in 1939 had a value of not far short of $2,000,000,000.

The rubber manufacturing industry is concentrated in countries which produce



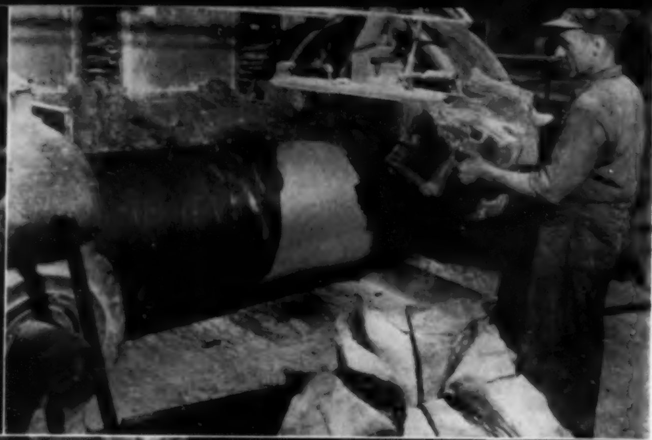
Top right:—Heated roll impresses design on soles and heels.

Centre:—Cleats are placed on the soles of boots and other types of heavy service rubber footwear.

Lower left:—Sewing room.

Lower right:—Vulcanizer into which large racks of shoes are placed, wherein they are cured under heat and pressure.

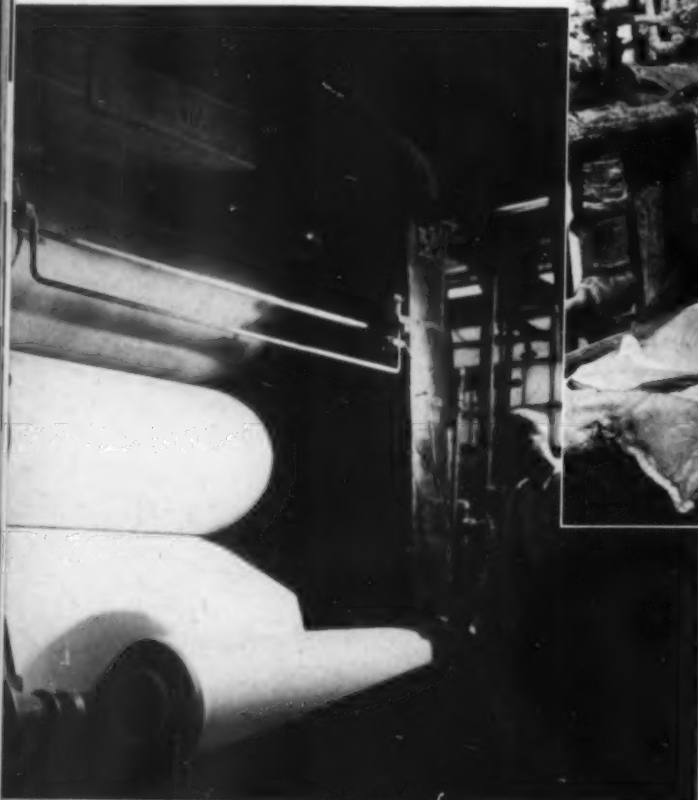
Photos courtesy Dominion Rubber Company, Limited



Top left:—From Malaya comes most of the raw rubber, in bales, to be made into tires, hose, belting and various other articles in every day use.

Top right:—The crude rubber from the bales, after being cut into pieces by a hydraulic knife is given a preliminary mastication in this mill.

Centre right:—Various chemical ingredients are mixed with the raw rubber to give it certain characteristics depending on the use to which the finished product is to be put.



Centre left:—Three-roll calender into which the rubber compound is forced and skimmed on the cord fabric used in building the tire carcass.

Bottom left:—Compounded rubber has been forced through an "extruder" and shaped to form the tread. The familiar tread "pattern" is later formed in the vulcanizing mould.

Bottom right:—Rubber already mixed with compounding ingredients being rolled into sheets or slabs ready for further processing.

Top right:—Built-up tires awaiting vulcanization. Formed in the shape of a drum the tire is pressed around a rubber core and then placed in the mould under heat and pressure to "cure" the rubber and to form the tread pattern.

Top left:—A battery of tire moulds where the tire is vulcanized and given the tread pattern.

Left:—The tread from the extruding machine is cut into lengths and then applied to the rubberized fabric of the tire carcass.

Right:—Cord fabric is formed by a number of twisted cords all running in the same direction with just enough very fine cross threads to hold the cords in position. The material must be thoroughly dry before the plastic rubber compound is forced into it.

Bottom left:—The rack behind the tire builder shows the different materials and stocks used to make up a tire.

Bottom right:—Tire moulds are made in two pieces and resemble huge watch cases.

Photos courtesy Dunlop Tire & Rubber Goods Company, Limited

none of the crude material. The United States is by far the most important and over-shadows all other countries in the absorption of rubber. In 1939 the United States accounted for over half of the world's rubber consumption. The United Kingdom comes next to the United States, and is first in some lines, such as waterproof clothing and golf balls.

Many of the large rubber companies are international in scope, but large and small-scale industries exist side by side. For the most part, tires are made in large plants, while rubber heels and many other products of rubber are made in comparatively small establishments.

The following table shows the absorption of crude rubber by the principal countries in the last three years:—

Consumption of Raw Rubber by Principal Countries

	1937 Tons	1938 Tons	1939 Tons
World	1,095,000	933,000	1,075,000
Principal Countries:—			
United States	543,600	437,000	577,000
United Kingdom	114,600	107,000	122,000
Germany	98,200	90,200	70,000
France	60,000	58,000	61,000
Japan	62,200	46,300	46,000
Canada	36,100	25,700	32,500
Russia (estimated)	30,500	26,800	25,000
Italy	24,000	28,200	24,000

The Industry in Canada

The rubber manufacturing industry of Canada is among the world's foremost. As shown in the above statistics, the Dominion was sixth among the nations in the absorption of crude rubber.

In view of the Dominion's high world position as a manufacturer of rubber it is not surprising that the industry is a very important part of Canada's industrial structure. With respect to value added by manufacture, it stood, according to 1937 statistics, sixth in importance among Canada's manufacturing industries. Fifty-three establishments represented a capital investment of $38,102,399 in land, buildings and equipment, and $26,752,049 in working capital, or a total of $64,854,448. They furnished employment to 12,879 persons, who received $14,061,788 in salaries and wages.

Production, valued at $61,000,000 in 1938, was considerably lower than that of the previous year. There were marked decreases in the volume and selling value of tires and inner tubes, production falling from $36,166,784 in 1937 to $28,786,804 in 1938. The output of footwear was also smaller, the volume decreasing from 17,944,182 pairs in 1937 to 17,646,495 pairs in 1938, and the value decreasing from $21,005,538 to $17,683,697. The miscellaneous section of the rubber industry, which includes such products as rubber heels and soles, rubber belting, hose, medical and druggists' supplies, mechanical rubber goods, etc., decreased its production from $17,091,431 in 1937 to $14,560,209 in 1938. For the rubber industry as a whole, there was thus a decrease of $13,233,043 in the value of production. There was also a decrease of 156 in the number of persons employed, but an increase of $20,722 in the amount of salaries and wages paid. Statistics on production of 1939 are not available, but production was higher than in 1938 and the immediate prospect seems to indicate increasing business. Imports of raw rubber into Canada for the twelve months ended March 31, 1940, at 83,671,944 pounds, are the greatest in the Dominion's history.

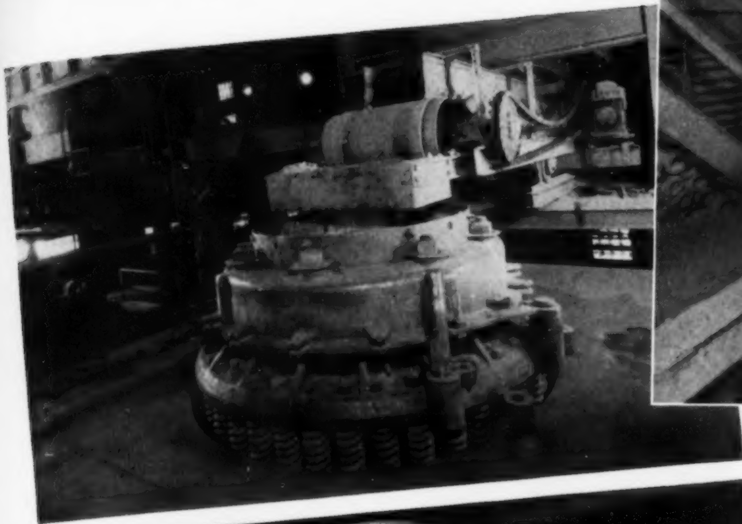
Beginnings

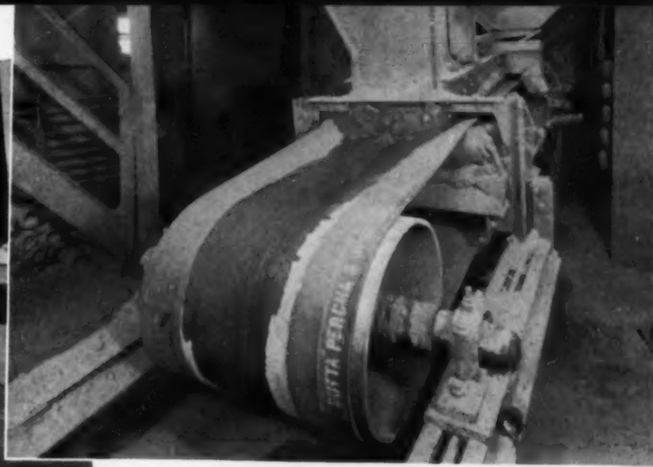
Rubber manufacturing began in Canada at a time when the world industry was still gathering speed and momentum for the spectacular advance which was to come. Building operations on the first rubber factory in Canada commenced in 1853 and manufacturing started in the spring of 1854. This factory was erected on ground at the corner of Monarque and St. Mary's Streets, Montreal, which factory now forms part of the Dominion Rubber Company, whose Papineau factory occupies the original site. The original factory of Gutta Percha and Rubber Company of Toronto was built in 1883. Another early producer was the American Dunlop Tire Company, now the Dunlop Tire and Rubber Goods Company of Toronto, which was in operation in 1894. In Canada the industry began to make its first real headway during the World War. The following figures showing imports of crude rubber give impressive evidence of its rapid growth.

Imports of Crude Rubber into Canada

(Fiscal Years ended March 31, 1910-1940)

Fiscal Years	Quantity Pounds	Fiscal Years	Quantity Pounds
1910	3,099,409	1926	46,986,814
1911	2,803,540	1927	50,224,614
1912	4,431,335	1928	58,187,688
1913	5,665,525	1929	77,704,022
1914	4,450,430	1930	73,327,150
1915	6,504,476	1931	59,522,523
1916	9,913,189	1932	55,258,014
1917	10,757,968	1933	41,077,906
1918	13,095,645	1934	51,148,547
1919	19,227,232	1935	63,618,101
1920	24,433,498	1936	56,915,391
1921	22,806,180	1937	62,546,059
1922	18,952,465	1938	78,791,841
1923	25,391,333	1939	62,617,210
1924	28,877,244	1940	83,671,944
1925	34,386,858		





Top left:—A conveyor belt feeding ore to cone crusher.

Top right:—Conveying copper concentration in a North-western Ontario mine.

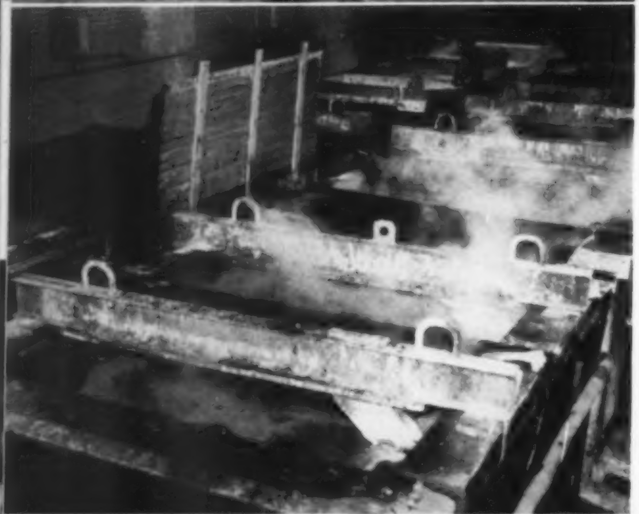
Centre right:—Conveying gold ore in a Northern Ontario mine.

Centre left:—Factory-made endless conveyor belt in use in prairie collieries.

Above:—A picking conveyor belt handling gold ore in a Quebec mine. Operators removing waste rock from ore.

Left:—The widest ever manufactured in Canada — a 90-inch conveyor belt used in a nickel mine.

Photos courtesy Gutta Percha & Rubber, Limited



It is interesting to speculate on the reasons which led to the development of the industry in Canada. Most of the large industries of Canada, such as non-ferrous metal smelting and refining, pulp and paper, flour and feed mills, saw-mills, etc., owe their emergence to the accessibility and abundance of their raw materials within the boundaries of the Dominion. This is not so of the rubber industry. It does not possess the natural advantage of having its raw material close at hand. It does, however, have a large market close at hand, and probably its rapid development, both for domestic needs and for export, is due largely to the increase

RUBBER SERVES DIVERSIFIED INDUSTRIES

Top:—Grinding operation of a large rubber-covered roll used in sealing a Minton Vacuum Dryer in a large Canadian paper mill. One such roll is used at each end of the vacuum drying chamber to allow the passage of a continuous sheet of paper without losing the applied vacuum in the chamber. Operating at relatively high temperatures these rolls must be very accurately ground.

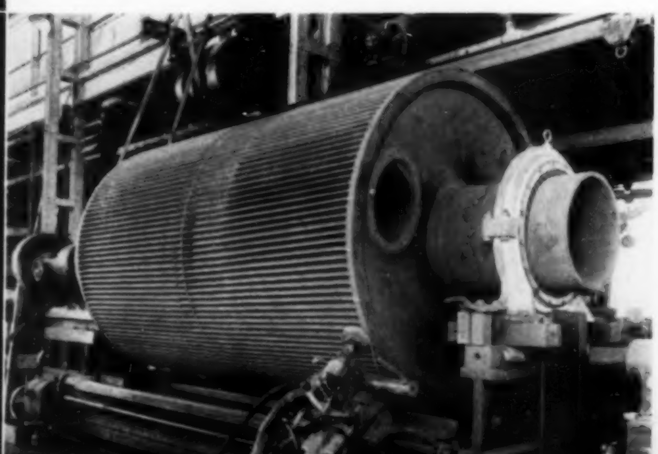
Centre top:—Rubber-lined steel pickling tank sheathed with brick for use in electrolytic pickling of rod coils prior to galvanizing. This steel wire, after galvanizing, is used in making wire fence by one of the large Canadian steel companies.

Centre bottom:—A Mesta type surge pickling installation in a large Canadian steel mill. Baskets of steel sheets are immersed in the three tanks in rotation, the first two of which contain hot sulphuric acid for cleaning the steel prior to galvanizing. These first two tanks are rubber-lined steel shells, the interior being protected from mechanical damage by an 8-inch brick sheathing. The rubber protects the steel shell from the extremely corrosive effects of the hot acid. The third tank is made of wood and contains cold water for rinsing.

Bottom left:—Rubber-lined steel vacuum crystallizer, 9′ 6″ diameter x 27′ overall length, used in crystallizing ammonium chloride in a large Canadian chemical plant.

Below:—A complicated machining operation—truing up the rubber ribs on the surface of the rubber-covered cylinder. The cylinder is a part of a large vacuum filter used in washing bleached sulphite pulp in a Canadian pulp mill. All parts of these filters must be protected with rubber for resistance to acids contained in the pulp stock and to prevent contamination of the pulp due to corrosion of exposed metal.

Photos courtesy Goodrich Rubber Company of Canada Ltd.



of motor transport and the necessity for rubber footwear. There is one automobile to every eight persons in Canada. This doubtless accounts for the large tire manufacturing industry which has developed side by side with the manufacture of automobiles produced for export as well as for use at home. Also, even motorists are sometimes pedestrians and the Canadian climate being variable, rubber footwear is necessary over a large part of the year. Production of other rubber products has accompanied the growth in the manufacture of the two main items.

Location of Industry

The rubber industry in Canada is practically confined to the Provinces of Ontario and Quebec; in 1938 only four of the fifty-three firms reporting production being outside of these two provinces. Ontario has seven of the eight firms reporting production of tires in 1938. Factories situated in the Province of Ontario produced over 80 per cent of the entire output of rubber manufactures; employed over 82 per cent of the capital, and 72 per cent of the persons engaged in the industry.

Size of Plant

The available statistics indicate that most of the production of the industry is done by large establishments, although there are a larger number of small establishments. Twenty-one of the fifty-three concerns reporting production in 1938 had an annual output of less than $100,000 each. Their production amounted to but 0.8 per cent of the total output of the industry which was valued at $61,000,000 in 1938. Eighteen firms had an annual production ranging from $100,000 to $1,000,000, and these produced 12.0 per cent of the total output of the industry. Fourteen firms had a production valued at over $1,000,000, and produced fully 87.2 per cent of the output of the industry.

Materials Used

Raw rubber is naturally the principal material used, being over 41 per cent of the total cost of materials in 1938, and 44 per cent in 1937. Nevertheless, the industry requires many other things and is an important customer of other industries. In all, the industry used materials valued at over $24,000,000 during 1938.

In addition to rubber, some of the specific items were:—Tire fabrics, valued at $3,400,000; belting duck, $659,000; shoe duck, $332,000; cottons, cashmerettes, velvets, etc., $2,078,000; fur, $338,000; leather, $336,000; carbon black, $459,000; zinc oxide, $377,000; unspecified chemicals, $1,408,000; wire, $280,000; hardware fittings, $467,000; shoe buckles and fittings, $299,000; containers and packages, $835,000.

Employment, Labour and Wages

The Dominion Bureau of Statistics reports that in 1938 the rubber manufacturing industry of Canada employed 12,879 persons, of whom 9,203 were male, and 3,676 were female. No breakdown is

Bottom left:—Sixty-foot, rubber-lined, brick-sheathed tank for continuous strip pickling.

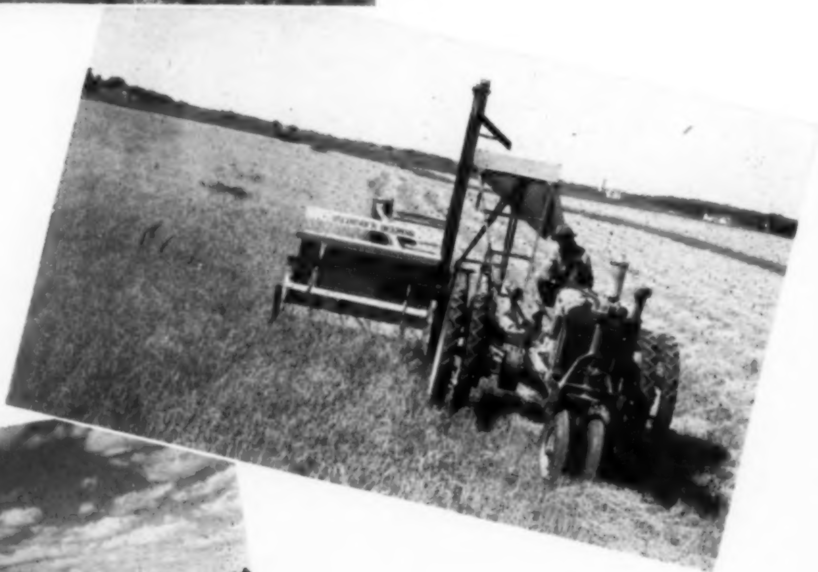
Bottom right:—Four rubber-lined steel tanks for electrolytic plating.

MODERN MECHANIZED FARM MACHINERY IS RUBBER-TIRED

Photos courtesy Firestone Tire & Rubber Company of Canada, Limited

Above:—Combine mounted on ground grip tractor tires.

Right:— A familiar harvest scene.



Right page:—Cultivating a field of corn.

Above:—Harvesting alfalfa.

Right:—Engineers checking new developments in farm tractor tires.

World's largest conveyor belt at Grand Coulee Dam is 9,700 feet long. Of 48-inch width and eight-ply construction, this belt was manufactured in eight separate pieces weighing 10 tons each. During installation the sections were vulcanized into one continuous endless belt weighing 80 tons. The completed belt required 30 tons of cotton and 50 tons of rubber for its manufacture. Moving at a speed of 450 feet per minute the belt will carry stone for an 11-minute ride, providing a flow of 2,000 tons per hour of aggregate required by the contractors for the project.

Courtesy Goodyear Tire & Rubber Company of Canada, Limited.

available showing the occupations among which these employees were distributed. For the year 1931, however, the decennial census shows that the industry employed over 14,000 persons. Of these, some 2,000 were labourers. There were 1,100 tire-builders and tube-makers. The tire-builder is a comparatively skilled worker, requiring training of not less than six weeks but more commonly up to a year. He performs at least seven operations, as follows:— Places two plies of fabric on revolving drum; places bead on each side of tire at rim; stitches fabric over head and adds more fabric; places a cushion and chafer strip over fabric; stitches down all fabric with small revolving wheels; places tread on drum and carefully stitches it again; and places his identification number on tread and throws it on conveyor. In 1938 he earned from sixty-five to eighty cents an hour, depending on his experience and skill, for a forty to fifty-five-hour week. Other occupations in the industry in Canada are many and varied. There are those peculiar to the industry and the material such as vulcanizers (154); compounders, moulders and spreaders (190); rubber shoe-makers (1,750). In addition there are numerous other occupations, including 15 pattern makers; 41 boiler firemen; 45 electricians; 26 painters, decorators, and glaziers; 41 plumbers, 90 truck drivers; 15 messengers; 51 chemists. One company even employs a watchmaker to constantly check automatic precision instruments.

In the rubber shoe and garment making trades there are more women workers, while in the tire trade the greater proportion is men. Throughout the industry the heavy preparatory operations of compounding, calendering and tubing are carried out by men, the employment of female workers being restricted to making up work where this is largely light in character.

The production of a fairly large number of rubber goods varies in quantity through the seasons of the year. The manufacture of such articles is often confined to large works which make a range of products so as to facilitate labour transference. It is difficult for this reason to attach any definite meaning to available statistics of wages in the rubber industry in different countries. The industry itself is not a unit. Where the rubber factory is, so-to-speak, incidental to the main trade of a locality, or is only a branch of a large factory, wages naturally tend to conform with those in the main industry. It can be said, however, that wages in the industry in Canada and in the United States rule higher than those in the United Kingdom, where they are again generally higher than in factories on the Continent of Europe.

The Royal Commission on Price Spreads in its report, published in 1935, alluded to the favourable wage position of the rubber industry. It was stated that despite a tremendous loss of business during the depression, the rubber industry had been able to avoid the ruthless price and wage cutting that characterized some of the industries discussed in the report. From 1929 to 1933 the gross value of all products decreased 58 per cent; the number of

employees 42 per cent; total pay-rolls 54 per cent.

Products

Of the three main classes of products manufactured in this industry in 1938 rubber tires and tubes accounted for $28,786,804 or over 47 per cent of the total; rubber footwear for $17,683,697 or almost 29 per cent; and other rubber goods for the balance of $14,560,209 or 24 per cent. Balloon tire casings, at $18,800,000, were the biggest item in the tire group in value. The high pressure tire casing, fast becoming obsolete, was next, valued at $6,529,049, while tubes, solid tires, and bicycle tires and tubes made up the remainder.

In a country such as Canada, where over one-third of the gainfully occupied are employed in agriculture, the application of the rubber tire to farm uses is of paramount importance. All sorts of garden and farm implements, from lawn mowers to heavy tractors, equipped with rubber tires, are now available. During 1939, 68.6 per cent of all tractors sold in the Eastern Provinces were equipped with air tires and 56.8 per cent of all tractors sold in Western Canada had this modern type of wheel.

Rubber footwear production was valued at $17,683,697 in 1938. The items were rubber boots—knee and hip, lumbermen's rubbers, overshoes, light rubbers, and rubber footwear with rubber soles and canvas uppers.

The miscellaneous section included mechanical rubber goods such as rubber belting, rubber hose, packing, tubing, plumbers' supplies, friction tape, and a number of other items. In addition, there is included in this group that whole multitudinous range of rubber articles that has been alluded to above. Most of these are produced in Canada. A quarter of a million dollars worth of baby pants and $40,000 worth of soothers and nipples were manufactured for the youngest age; $6,000 worth of hockey pucks for the boys; $173,000 worth of miscellaneous toys and balloons for juveniles of both sexes; $60,000 worth of rubber tobacco pouches for the men; $40,000 worth of bridge-table covers for the women; equipment for the housewife, the golfer, the bather, the motorist, the doctor, for people of all sorts and descriptions, sick or well, awake or asleep.

Export Trade

Canada has an extensive export trade in rubber goods. Only in rubber clothing and miscellaneous articles do imports exceed exports, and are high relatively to

This "Marsh Buggy" used to locate oil in Louisiana marshland, is equally at home on land or water. It is equipped with specially constructed tires that stand ten feet high. These tires share the honour with the tires used on Admiral Byrd's "Snowmobile" (a vehicle used in exploring Antarctica), of being the world's largest. Although the "Marsh Buggy" weighs 7,500 pounds, it sinks only two feet in water.

Courtesy Goodyear Tire & Rubber Company of Canada, Limited.

Left:—Crude rubber and compounds, after being measured into batches, are mixed between huge rollers of the mixing mills. Tremendous pressure is exerted on the mixture as it goes between the rollers.

Centre left:—After the rubber and compounds have been thoroughly mixed on the mill the material is passed up through an extruding machine which shapes the rubber to form the tire tread.

Below:—On huge calenders the fabric is impregnated with rubber from the mill as it passes through the rolls. Lower roll shows the frabric after having rubber forced into it.

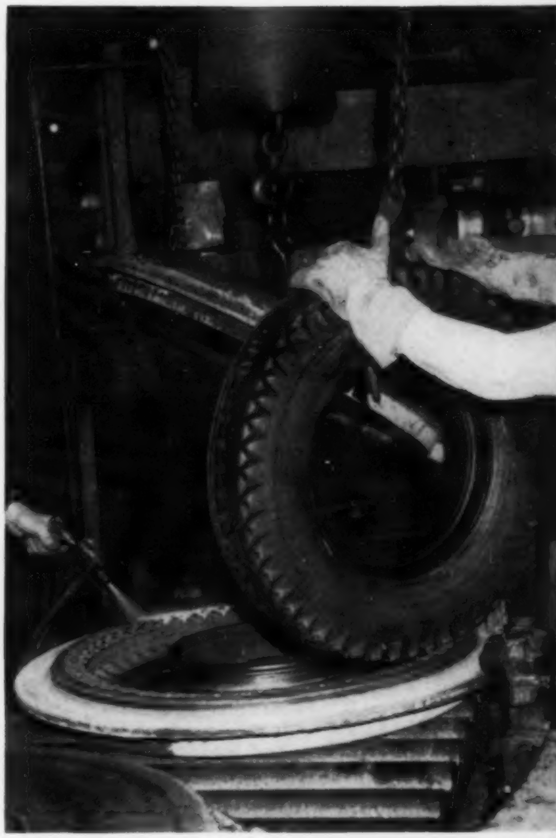
Above:—Fabric used in tires is cut into strips in which the cords run at an angle instead of parallel to the side of the strip. The machine is known as a bias cutter.

Left:—Each tire has to be built by hand, and is constructed ply by ply. This tire builder is pressing down the tread.

Right:—A mould in which tires take their final form, is just being raised from the vulcanization pit which reaches a temperature varying from 260° Fahrenheit.

Centre right:—A tire just taken from the mould while one worker cleans the mould ready to take the next tire.

Below:—While conveyor belts carry the tires along, they are painted, shaved, the house flag put on and, finally, they are inspected.



Above:—The final act before shipping—the tire is wrapped by a fast-moving machine.

Right: — All tires are subjected to a thorough final inspection.

Photos courtesy Goodyear Tire & Rubber Company of Canada, Limited

the domestic production. In the years 1938 and 1939, combined, exports of finished rubber products were greater by about 50 per cent in value than imports of raw rubber for the manufacture of goods for both domestic use and export abroad. Canada's markets for rubber products in peace-time include practically every country of the world, even including the great industrial countries which themselves are large manufacturers of rubber goods. Exports of rubber goods were valued at $15,700,000 in 1939.

* * *

To-day the rubber industry is helping to meet the urgent necessities of war. Gas masks, parts for military aircraft and other mechanized equipment, and waterproof equipment for soldiers, are some of the things needed in the struggle.

For the future, an even more fruitful career of service can be predicted for the rubber industry than it has had in the past. Scientific research in rubber processes and applications is still in its infancy, or, at most, early adolescence. New uses, applications, and adaptations of old uses are

Top:—Rubber-tired equipment facilitates farm work.

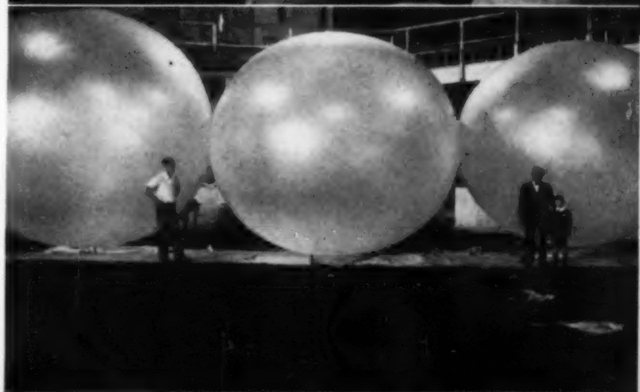
Centre top:—Machines of amazing complexity and speed form the braided reinforcement around the original rubber tubing.

Centre Bottom:—Porcelain forms ready for dipping latex gloves.

Lower left:—Millions of rubber bands are used in offices every year — this shows them coming from cutting machine where they have been sliced off a long rubber tube.

Below:—Careful testing at every stage is essential for producing golf balls of uniform performance.

being discovered with astonishing rapidity. It is possible that new materials having rubber-like qualities, will be produced in quantity. These may supplant rubber itself in some fields and supplement it in others. The vicissitudes which skyrocketed the price of crude rubber to over three dollars a pound and dropped it to less than three cents within a generation, have now been brought to comparative stability. The once insatiable demands of a new transport era for tires, prodigious though it will remain, need no longer tax the capacity of the industry to the exclusion of incentive for progress in other uses. The rubber industry has had a brief but brilliant career thus far. Its future potentialities are bright.



Top:—Pneumatic tires used in logging operations.

Centre top:—Rubber play balls being decorated by spray gun.

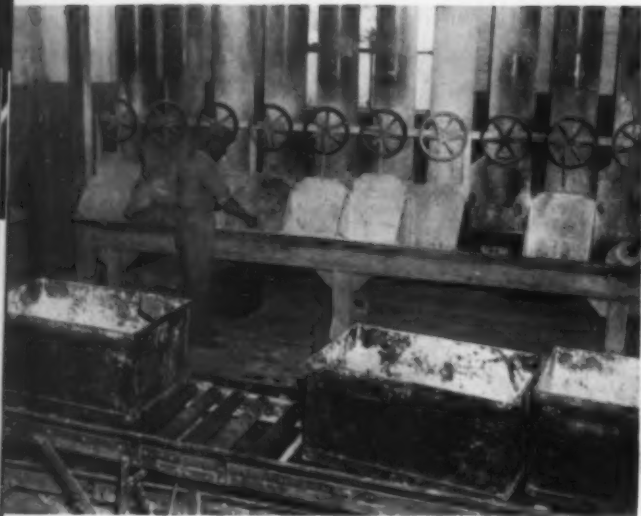
Right:—Rubber balloons of three to fifteen feet in diameter.

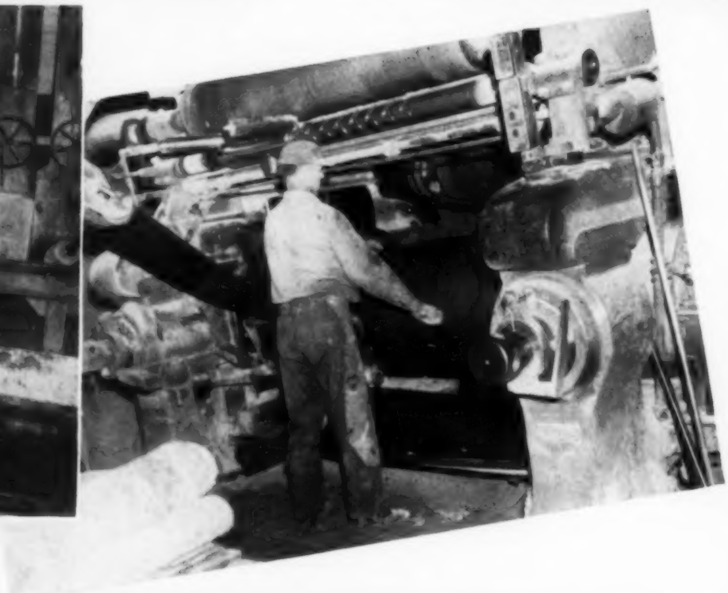
Bottom right:—"Gumshoes" for "old Dobbin".

Bottom centre:—The rubber handle is a protection against electricity.

Centre bottom:—Two lines of six-inch rubber pipes.

Photos courtesy:
Viceroy Manufacturing Company, Limited
Sterling Rubber Company, Limited
Dunlop Tire & Rubber Goods Company, Limited

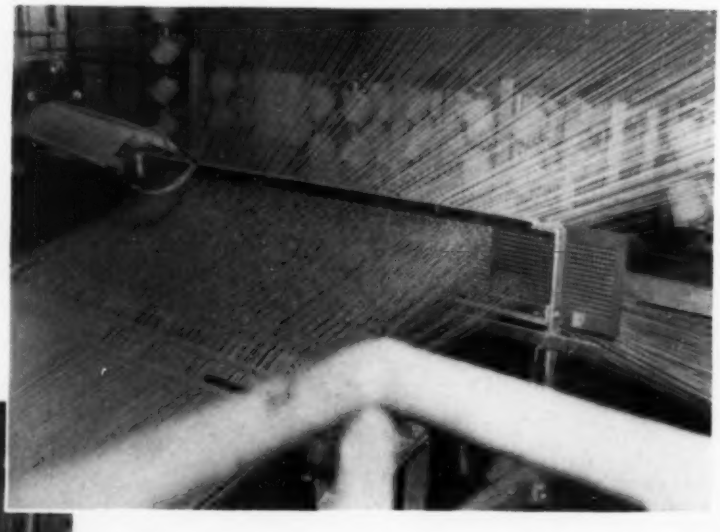




Top left:—Bale cutter.

Above:—Compounding room.

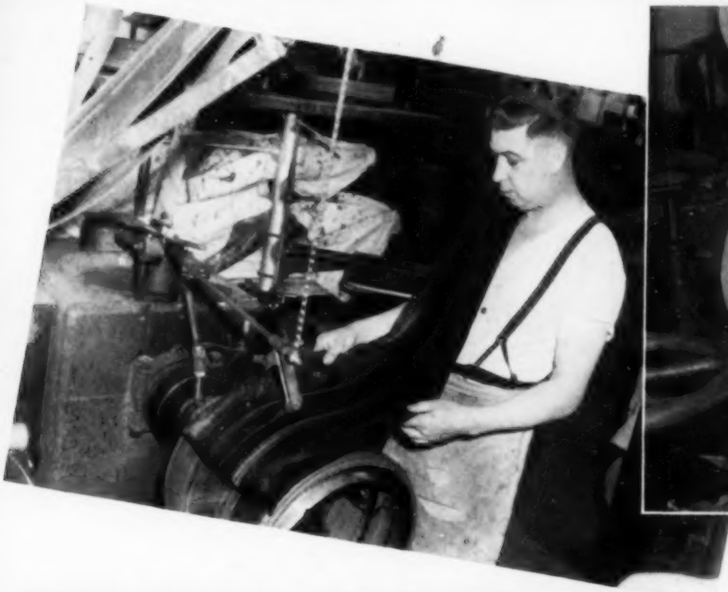
Centre right:—Barnbury Mill, mixer.



Above:—Web machine creel.

Left:—Web machine from front.

Top centre:—Friction calender No. 3 Skimcoat.



Top right:—Bias cutter.

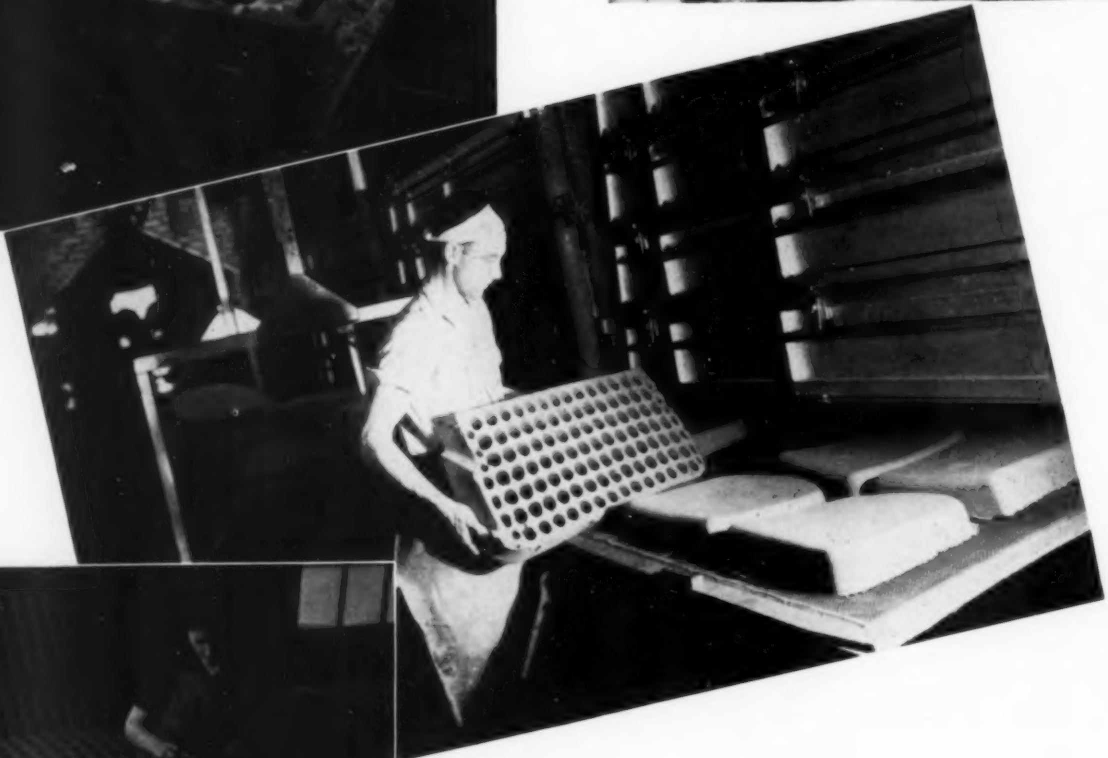
Above:—Building a ten-ply truck tire; fourth ply going on.

Centre left:—No. 13 tire-building machine; putting on thread.

Above:—Vulcanizing operation.

Right:—Shipping warehouse.

Photos courtesy Dominion Rubber Company, Limited



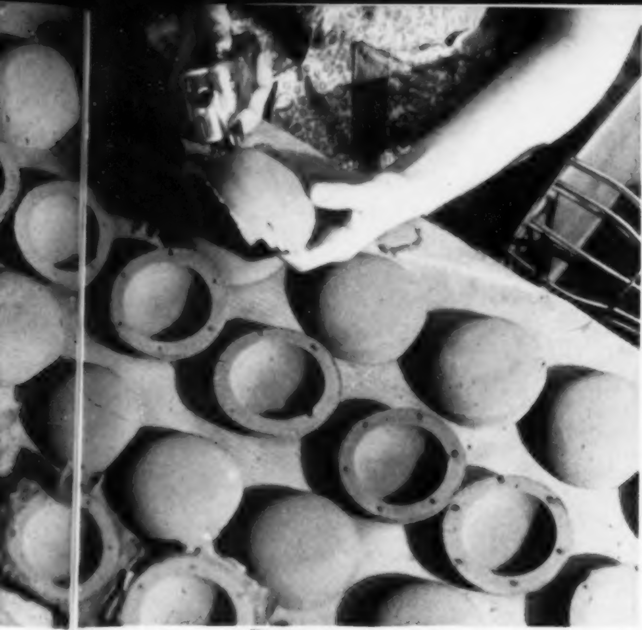
PROCESSES IN

Top left:—Latex cushioning being removed from the mould.

Centre:—Drying after curing.

Left:—Automobile seat cushions receive their final trimming.

Top centre:—Trimming small pads after removal from the moulds.



N

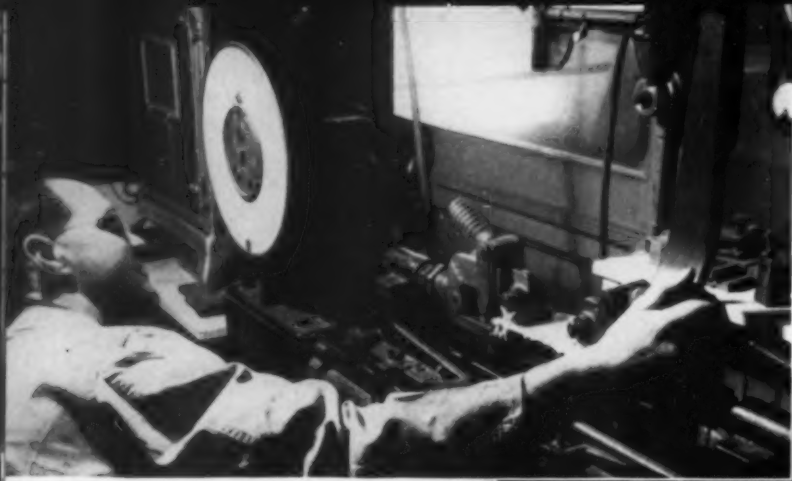
CUSHIONING

Top right:—Each cushion is carefully tested for density — or softness.

Centre:—After the latex has been "whipped-up" or frothed, something like whipped cream, it is poured out into moulds for curing.

Right:—Cushioning is moulded in a great variety of shapes.

Photos courtesy Dunlop Tire & Rubber Goods Company, Limited



IN THE LABORATORY

Left:—Testing fabric used in rubber belting.

Below:—Curve testing.

Left:—Tensile strength of rubber is tested.

Lower left:—Single strand cord tester.

Below:—Chemistry is a vital factor in rubber manufacture; samples of every shipment of every ingredient used in the finished product are checked for quality by skilled chemists.

Photos courtesy Dunlop Tire & Rubber Goods Company, Limited and Dominion Rubber Company, Limited

EDITOR'S NOTE-BOOK

Arthur L. Neal, whose previous articles in the Journal have met with such general approval, contributes in this number "Rubber and Its Manufacture in Canada". A native of Nova Scotia, Mr. Neal was educated at Acadia University and at the London School of Economics, London University, England. Former acting-chief of the External Trade Branch of the Dominion Bureau of Statistics, Department of Trade and Commerce, the writer was Statistician for this branch for eleven years and is at present Director of Economic Research with this Department.

John Hockin, London, England, the writer of "Rubber Plantations of Asia" is a retired Ceylon rubber planter and a contributor of articles on rubber to many publications all over the world. He is also the author of several books on the East and is special correspondent for three well-known Indian newspapers.

Flying Officer J. Fergus Grant, who contributes to this issue an article on the British Commonwealth Air Training Plan, is Press Liaison Officer for the Royal Canadian Air Force. He has wide knowledge of the development of aviation in this country, having been Aviation and Marine Editor of the Montreal *Gazette* for eleven years. In this capacity he flew the Atlantic in 1930 aboard H.M. Airship R-100. He was staff correspondent of the *Canadian Geographical Journal*, and wrote extensively on aviation subjects. One of his articles, "Across Canada by Air", was reprinted by request for Trans-Canada Air Lines. He has travelled extensively throughout the world, and has studied aviation activity in other countries. Prior to mobilization on the outbreak of war with the First Survey Regiment, Royal Canadian Artillery, and his transfer to the R.C.A.F., Flying Officer Grant was Press Liaison Officer for Imperial Airways, Limited, in Canada, his duties pertaining in particular to the transatlantic service of that company.

ERRATA — JUNE ISSUE

P. 296, line 31:—"South of Strasbourg" should read "north of Strasbourg".

P. 301, line 52 (in table):—Belgium is noted for coal, not oil.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EDITOR'S NOTE-BOOK—*Continued*

Acknowledgment is made of the valuable assistance rendered by the various rubber manufacturers in Canada in providing specially taken photographs to meet Canadian Geographical Journal requirements and provide readers with a realistic up-to-the-minute photographic representation of the multi uses of rubber, its manufacture and application. We further wish to acknowledge the co-operation of companies and the Dominion Bureau of Statistics in supplying data. The presentation of illustrations was selected from several hundreds of photographs supplied, and, of necessity, those credited to specific companies in no way circumscribe their respective activities.

AMONGST THE NEW BOOKS

Oxford, (London: Batsford, 1939, 8/6 net). Books about Oxford must be almost as numerous as those about London, yet this latest one by CHRISTOPHER HOBHOUSE has a quality and value out of proportion to its modest size. Its one hundred and twenty pages of text are illustrated by over one hundred and thirty pictures, the finest selection, we are told, which has yet illustrated a book on Oxford. They have been chosen, on the one hand from such old sources as Loggan's Oxonia Illustrata (1675), from Rowlandson's inimitable sketches and from Ackermann's History of the University, and on the other, from the best modern photographs. There are, besides, interesting maps and colour plates.

The growth of Oxford from earliest times is Mr. Hobhouse's theme, and if the architectural interest and knowledge predominate, we are also introduced to a curious crowd of personalities memorable for valour or learning or eccentricity, but all having their part in building up the Oxford tradition. The author's method is one of comparison. He describes in turn the Oxford of Medieval, Renaissance, Reformation, Classical, Nineteenth Century and Modern Times, and often each section gives an account of what remains to-day of the buildings of the period.

As a guide to the University it could hardly be bettered, but it is much more than a guide or even a history. Mr. Hobhouse has very decided views and deals trenchantly with the iconoclasts whose misguided "improvements" have spoiled some of Oxford's lovely architecture. Nor does he attempt to conceal his dissatisfaction with what he considers the hurrying scientific, materially-minded Oxford of to-day. But he concludes, "In spite of modernistic jerry-building the old foundations are sound, and the old walls will stand for many generations. For many a thousand years now Oxford has by its quiet example taught dignity and the love of truth to the youth of England. There is still no place where a young man can acquire these virtues or more lastingly embrace them."

F. E. FORSEY